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Design, Construction, Operation and Maintenance of all Public Works

When Will Engineers Be Better Paid?

Of late there has been considerable discussion of the financial status of the engineer with special reference to the period of the war and the period of reconstruction which inevitably must follow the war. Many there are who hold that engineering is on the eve of becoming the most lucrative of professions. Others who have long hoped, and perhaps occasionally prayed, for better pay for the engineer, without noting any material increase in his stipend incline toward the pessimistic view that engineers will continue to receive relatively low salaries. What are the facts and what conclusion may confidently be predicated upon the facts?

Here are the facts: Heads of engineering schools all over the country are reporting that the supply of graduates is wholly inadequate to meet the demand. No over-supply of graduates is in sight and a dearth of graduates is now present and is likely to continue. Considerable numbers of engineers are being drawn into some form of military service or some work closely allied thereto. The longer the war continues the greater will be the diversion of engineers from civil to military pursuits. One consulting engineer reports that the government is taking his best men as fast as he can train them. During the construction season now drawing to a close many employers of engineers have reported difficulty in getting men. In some sections of the country 25 per cent. increases in engineers' salaries have been noted.

Now what conclusions may we draw from the facts as stated? First, the elemental economic law of supply and demand is even now operating in the engineer's favor and will continue to do so as long as the demand for engineers exceeds the supply. This condition may continue for months, perhaps years, to come. Everything considered it is more likely to be months than years. Whether this period of better days for the engineer, based on the workings of the law of supply and demand, continues for months or years it must all too soon end and then the pendulum will swing in the opposite direction. Then what? Low salaries again, probably for an indefinite period **unless** engineers embrace the plan of collective bargaining in some form.

The turning point of this discussion is that word **unless,** which is an own cousin to another innocent appearing word, namely, **if. Unless** engineers agree among themselves to demand better pay they will not get it, excepting during short periods like the present emergency; but **if** they agree to demand better pay they will certainly get it and will as certainly continue to get it for an indefinite period.

Anyone who has followed the discussion of the status of the engineer for the past twenty years must recognize the fact that the engineer's economic salvation cannot be achieved by faith and works alone. The engineer has won the admiration of the entire community with his works, and his faith that eventually he would be well rewarded for his works has done him great credit, from certain viewpoints. But he has gone on year after year, still hoping and still achieving without getting his proper money reward. Meanwhile, let it be said, he has been happy in his work and in feeling sorry for himself because he was so poorly paid. He has used enough paper in discussing his pay to cover the earth and has also exhaled enough breath in the same discussion to cool a great deal of porridge. Despite all this sort of discussion engineers have continued to draw low, discouragingly low, sometimes ridiculously low, salaries.

The inevitable conclusion of any careful study of this question is that engineers will continue to draw low salaries as long as they will work for them. Meanwhile discussion of the question is not wholly without value as men can talk themselves up to the point of making even a bayonet charge. Perhaps after some more years of discussion engineers will begin to ask themselves: "What are we going to do about it?" After some more discussion somebody will suggest that engineers must demand better pay. Again, after still further discussion, the suggestion will be adopted. Then, and not until then, will the engineer become a permanently well-paid professional man.

The 1920 Presidential Election.

The 1920 presidential election is still far away, thanks be to Allah, but its shadow even now flits across the business doorway occasionally. One or two irrepressible politicians seem unable to forget partisan politics even in the first year of what may be a long war and show symptoms of breaking out with virulent partisan attacks on the government. It would be a blessing of the first order if the politicians could be kept quiet until about July 4, 1920. There would be ample time after that to do the inevitable pointing with pride and viewing with alarm. Of course that is too much to expect but business men have a right to ask that politicians wait much longer than usual before beginning the manufacture of opinion.

Business men will do well to frown on partisan political discussions during the war. The conduct of the war and the results of the war will loom largest in the issues to be fought out at the polls at the next presidential election. This is inevitable. There will be ample time to apportion political rewards and punishment before the next big election, even if we wait until midsummer, 1920, so let all sensible men turn a deaf ear to the politicians who, if given the least encouragement, would steal our time and hurt our business with their palaver all during 1918 and 1919.

"Pork" and Waterway Development.

So savage at times have been newspaper attacks on Congress that all sorts of construction paid for by federal money have been lumped together and branded as "pork." Thus a year ago one set of newspapers called the federal aid road appropriation law a pork law. The annual River and Harbor Bill is always called pork barrel legislation by a section of the lay press. The River and Harbor Bill of 1917 was denounced as pork legislation and some citizens were known to justify their lukewarmness toward the Second Liberty Loan by the assertion that: "Congress will not give up its pork, even in war time, so why should I make sacrifices to aid the government?"

There is neither disposition nor ability to deny that some River and Harbor Bills have been well stocked with "pork." But this is not true of the 1917 bill at least. This bill carried but $27,826,150 and its passage through House and Senate was rendered difficult by the accusing cry of "pork." This cry was raised by that coterie in Congress which, for demagogic reasons, is always "against the government," and by many newspapers which should have known better and who doubtless did know better.

This charge has been refuted by the Atlantic Deeper Waterways Association in a statement entitled: "Why not Tell the Truth About the River and Harbor Bill?" The statement points out that the bill, drawn in accordance with the estimates of the Chief of Engineers of the United States Army and approved in advance by the Secretary of War and the President, is a wise and practical measure as a study of its schedules will show. The statement implies that the criticisms of the bill, which went the rounds of the newspapers, were due to the fact that editors found it more convenient, under pressure of other work, to use the same old ready-made and time-tried statements that have been used against all such bills in recent years than to analyze the bill. These statements and phrases include: "Waste and extravagance," "no practical need for the work," "millions going into little creeks," "rivers that ought to be paved," "streams that should be stood up on edge," "chunks of pork," "items tacked on for individual members," and, where sectionalism still appeals, "The most is intended for distribution in the South." The Association denied all these allegations and challenged members of Congress and representatives of the press to cite facts in support of them.

How ridiculous are the claims against the legitimacy of this bill may be seen from the fact that 51.5 per cent. of the money it provides is for the improvement and maintenance of ocean harbors, 8.1 for inland lake harbors and channels, 31.3 per cent. for five leading rivers, 1.2 per cent. for examinations, surveys and a commission, and the remaining 7.9 per cent. covers all other projects in all parts of the country.

These facts are cited here for a variety of reasons. First, they show that Congress is not wasting public funds and thus forfeiting claim on popular support of the war; second, they should indicate to everyone the unfairness and folly of catching up the cry of "pork" every time it is uttered by certain newspapers; third, they should restore public confidence in river and harbor legislation and, fourth, this should lead to the early, intelligent and extensive waterway development which is essential to the growth and prosperity of this country.

The Metric System.

Our old friend of the college classroom, the metric system, is just now receiving somewhat more attention than usual in English speaking countries. The advocates of the system are not more enthusiastic than they have been in recent years, but those who oppose the system are more outspoken in their opposition than ever before.

The present view in England is well summarized by a prominent civil engineer as follows: "We cannot change over to the metric system. Only one-quarter of mankind employ it, and half of these are our bitter enemies and unfriendly. To alter our ancient systems to suit Belgium, Serbia and Roumania is to burn the house down to secure some roast pig. Russia, our great and valuable neighbor and ally, is non-metric and already uses the foot, inch, yard and pound weight. I submit that if the Belgians, Serbians and Roumanians have a spark of gratitude for Britain and the United States of America they will accept my suggestion (to adopt the foot, inch, yard and pound weight), without hesitation or demur." This expression of opinion was brought out in connection with a discussion of the rebuilding of the portions of Belgium, Serbia and Roumania laid waste by Germany.

This view is important as it is representative of present feeling in the British Empire. With the war daily drawing the English speaking countries closer together in all things and with the British firmly opposed to a change the chances that America will adopt the metric system are extremely remote.

Solving Engineering Problems by Popular Vote.

Occasionally a city settles its engineering problems by a vote of the people. An extreme example of this particular kind of folly occurred in a West Virginia city a few years ago when the city called an election at which the people voted their choice between two contending systems of water purification. The experts disagreed so the utterly inexpert plain people were called on to decide by their votes.

Recently, property owners in an Oklahoma city decided on the type of pavement to be constructed. The proceedings were delightfully informal. The members of the city council and the property owners assembled in the court room. Standing room was at a premium. The mayor presided and announced as the object of the meeting the making of a choice of paving materials.

Each sales engineer, representing a paving company, was allowed fifteen minutes in which to explain the merits of his product. Five men spoke for a total of one hour and fifteen minutes and the assembled freeholders took it all in "profound as prairie dogs." Then they voted and the cheapest pavement, cheapest in first cost, was an easy winner.

Ninety-nine times out of one hundred the people, if given a chance, will vote for the thing that costs least to start with. This is only natural and might be expected for the first cost is the only thing that means anything to the voters. Since the thing that is cheapest to begin with is not always cheapest in the long run the folly of letting the people vote on such matters is evident. The principle, moreover, is absolutely wrong, as such questions are highly technical and should be decided by trained experts, acting for the people who are incompetent to decide for themselves.

Solving the Water Supply and Sewerage Problems at the Camp Pike Cantonment

By E. B. Black, of Black & Veatch, Consulting Engineers, Interstate Building, Kansas City, Mo.

Camp Pike, the cantonment for the Twelfth Division of the National Army, is located on a 3,000-acre tract of rolling and heavily wooded land, about 5 miles north and west of Little Rock, Ark. The buildings on the camp site are permanent wooden buildings, to accommodate 43,000 men. On the camp site is also a base hospital of 1,000-bed capacity.

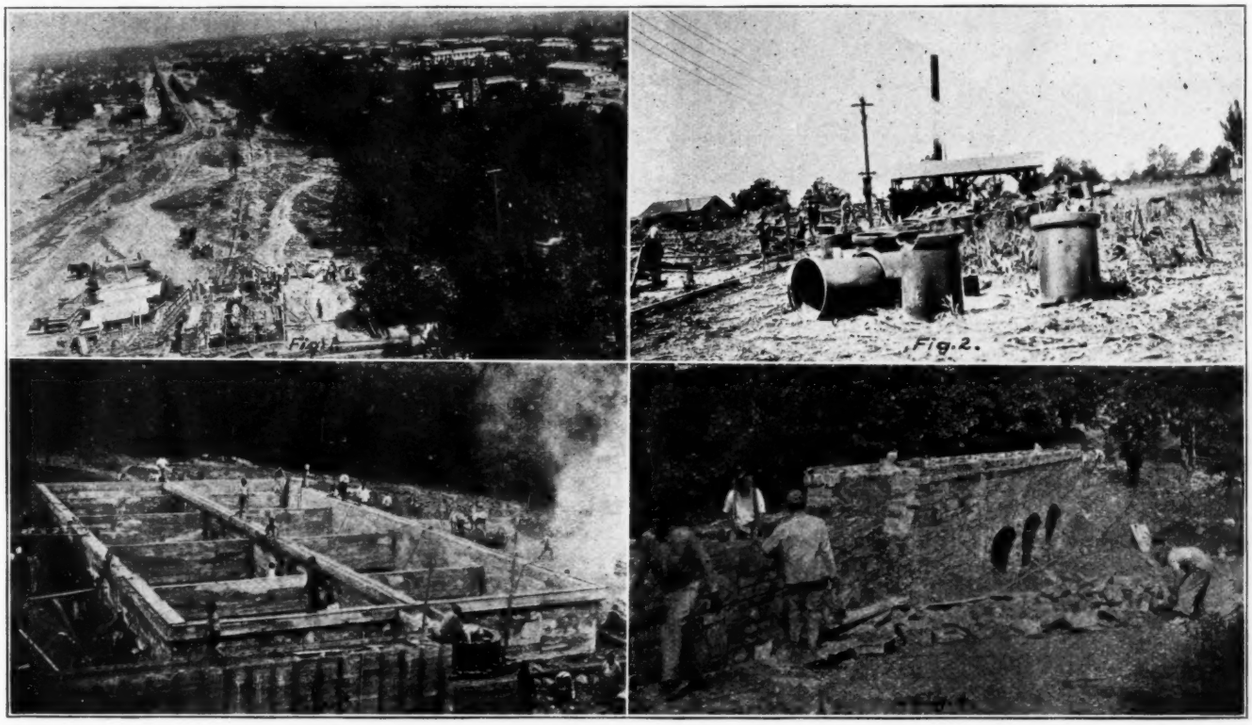
Electric Power

Electric light and power is purchased from the Little Rock Electric and Railway Company and is transmitted to Camp Pike over a 3-phase, 60-cycle, 13,200-volt line to a transformer station on the cantonment site, where it is stepped down to 2,300 volts.

Arkansas River valley, in or near Argenta, 5 miles from the cantonment. Such wells would furnish a sufficient supply, but contained from 2 to 16 parts of iron, and in some cases showed manganese.

The Arkansaw Water Company supply is drawn from the Arkansas river, and at times when the river water has a high chlorine (Na Cl) content, well water is mixed with it for the purpose of dilution. The mixed water is then filtered and treated with liquid chlorine before going to the consumer.

The government entered into contract with the Arkansaw Water Company for a supply, and built the pipe line from the city of Little Rock to the cantonment. Water is delivered at



VIEWS ON CONSTRUCTION OF CAMP PIKE CANTONMENT. FIG. 1—PUMP HOUSE WITH PUMP INSTALLED AND WALLS BEING BUILT. FIG. 2—AIR COMPRESSOR PLANT AND ELECTRIC LIGHT AND POWER LINES ON 23-FOOT SEWER CUT. FIG. 3—SEPTIC TANK READY FOR ROOF. FIG. 4—NATIVE STONE ARCH FOR CARRYING SEWER ACROSS RAVINE.

The electric construction involved no special problems excepting that it was necessary to secure about 4,000 kilowatt capacity in transformers, from 100 to 700-k.w. units, between July 7 and September 1. The transformers were ordered, built, delivered and erected on time.

The Water Problem

The water problem was difficult, in that a sufficient supply from wells or impounding reservoirs on the camp site was impossible. A temporary supply for construction purposes was obtained by tank trucks from Argenta, 5 miles away, and from four wells on the camp site, ranging from 60 to 100 ft. in depth.

Preliminary surveys showed two possible sources for the permanent supply of from 2,250,000 to 2,500,000 gallons per day: (a) To purchase water from the Arkansaw Water Company, of Little Rock, or (b) to develop wells located in the

the Little Rock end of the free bridge across the Arkansas river at about 60 lbs. pressure. It is conveyed by a 12-in. wrought-iron pipe line 1,700 ft. long, across the bridge, and by a 16-in. cast-iron line 1,300 ft. long to a meter station owned by the water company. Here it enters a 16-in. pipe line of California redwood and is delivered to a 100,000-gal. redwood tank at a booster station about midway between the city and camp. The booster station has three belt-driven Platt Iron Works centrifugal pumps, each with a capacity of 750 gal. per minute, against a 300-ft. head. These pumps are driven by 3-phase, 60-cycle, 2,300-volt, 100-h.p. motors.

The force main between the booster station is also 16-in. California redwood, and delivers the water to five 100,000-gal. redwood tanks on the cantonment site.

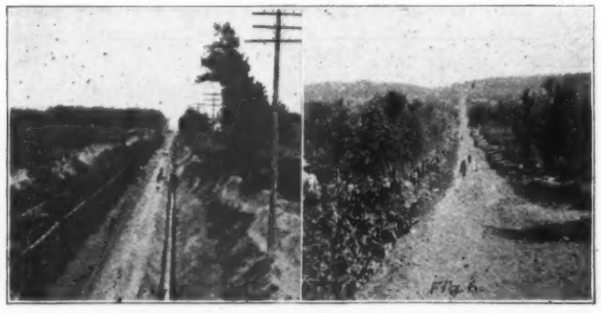
From these five tanks the water is distributed about the camp by direct pressure through four Allis-Chalmers direct-

connected motor-driven pumps, two of 1,000 and two of 1,200-gal. per minute capacity.

The distribution system about the camp consists of 12, 10, 8 and 6-in. cast-iron and wood pipe, with a total of approximately 290 two-way fire hydrants. The storage tanks and direct pumping station are located about the center of the tract (1 mile by 2 miles) occupied by the camp, and part of the camp can be supplied by gravity from the tanks. These tanks are 16 ft. deep and 48 ft. in diameter, set on concrete piers, high enough to bring them to equal elevations above the ground surface, with a minimum ground clearance of 12 in. Two of the temporary wells are being fitted with deep well pumps and motors for use in cases of emergency.

The Sewer Problem

The sewer problem at Camp Pike was difficult, due to the fact that the south half of the camp drained to the Arkansas river above the city of Little Rock and the other half to the same river some 60 miles below Little Rock.



FIGS. 5 AND 6—SIXTEEN-INCH REDWOOD FORCE MAIN CONSTRUCTION BELOW AND ABOVE BOOSTER STATION.

It was necessary to take the sewage from the south half of the camp through the divide by means of a short cut 23 ft. deep. The average depth of trench for the entire sewer system was about 4.5 ft., and approximately one-half the excavations on trunk sewer lines was in rock ranging from trap to sandstone.

Trenching machines were used with some degree of success on part of the mains and laterals, but for the most part hand work was necessary.

Steam and electric compressor stations were set up along the line of work and moved to new locations as a given section of the trench was finished. On part of the trunk lines electric lines were erected and much of the drilling and pipelaying was carried on day and night.

A portable lighting plant consisting of a Delco engine and batteries, mounted on a wagon, was used to good advantage for night work on both water and sewer lines.

The original plan included a septic tank for sewage disposal, but as the effluent from the plant has to be emptied into a dry ravine, sprinkling filters were authorized later and are now being built.

The original plan of about 25 miles of sewers and septic tank, about 30 miles of water lines and two pumping stations, were designed by the engineers and built by the contractors in 60 days, under the engineers' direction.

The high record for sewer pipe laying in a single day was 5,900 ft. of all sizes of pipe.

Personnel

The construction of the camp was under the direct charge of John R. Fordyce, Major Engineers, U. S. R., constructing quartermaster, with Black & Veatch, consulting engineers, in full charge of the design and supervision of construction of sewers, sewage disposal, water supply and pipe lines, and electric light and power. James Stewart & Co. were the general contractors.

The Relations of the Engineer to the Contractor

By S. M. Swaab, Philadelphia, Pa.

In every instance the contractor should receive a square deal at the hands of the engineer and in no instance should the engineer have it in his mind to get square with the contractor for some fancied or even real act of omission or commission. Those who have had sufficiently broad experience recognize that specifications are intended to be interpreted in the spirit, rather than in the letter. As Theodore Cooper, in his day recognized as the foremost bridge engineer in this country, put it, "The best system of rules to insure success must be interpreted on the broad grounds of professional intelligence and common sense."

Relations Should Be Cordial

Constant bickering, indicating lack of poise and persistent petty fault-finding without being able to offer suggestions for the betterment of conditions, is the method pursued by many young engineers to the detriment of the work on which they are engaged.

There is absolutely no reason why the most cordial relations should not exist between the contractors and engineers engaged on the same work and there are probably the very best of reasons why they should, as their interests are alike, said Mr. Swaab in addressing the Engineers' Club of Philadelphia.

The specifications are often the rock on which the cordial relations of the engineer and the contractor are rent asunder.

Contractors, like engineers, are actuated by the same motives as other men. The engineer may or may not be superior to the contractor, but he cannot show his superiority by taking undue advantage of him.

Much Grief in Contracting

Contracting, according to the usual methods in vogue, of which some one has aptly said, "The profits are limited by competition, but the losses may be unlimited," should no longer prevail, but as it is or should be a legitimate business, the gambling element should be removed therefrom, and should certainly not exist to a greater extent than it exists in any other ordinary business.

Contractors would be better men as well as better contractors if their remunerations were fixed, rather than problematical as is usual.

The party for whom the work is being done should take all of the incumbent risks, and then any incentive of the contractor to take advantage is removed.

Misusing Specifications

Some specifications deliberately give the engineer the whip-hand, but it has been determined in the courts of this country that it cannot be employed without considerable danger. As engineers we know that the action and reaction are equal.

Clauses which have a double meaning or which can be interpreted in two ways should not be written in specifications. A contract represents a meeting of the minds of the contracting parties. The engineer should not attempt to protect himself by inserting obscure clauses in specifications whereby he may cover up his own ignorance or shortcomings at the expense of the contractor.

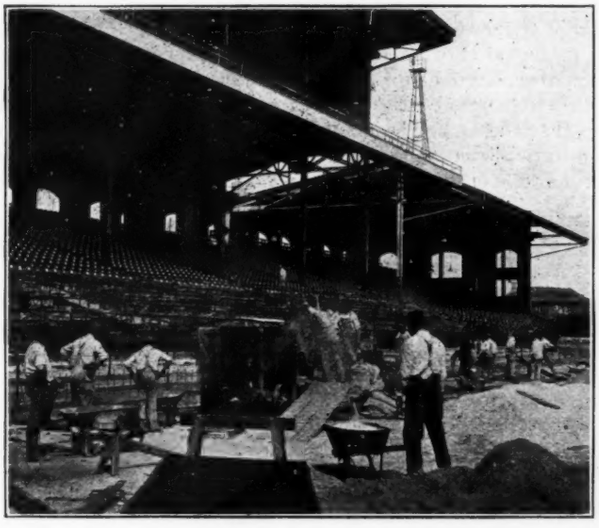
Copying clauses from one specification into another without fully understanding their meaning, simply because they are time honored, i. e., because custom has sanctioned them, which is not unusual, is a very silly and at the same time dangerous practice.

Few men have ever been vested with considerable power who haven't at times abused it, and the engineer who prepares the specifications and who interprets them and who in the case of dispute has the last say, in fact is the "sole arbiter," has to be a bigger man than the ordinary to be absolutely unbiased. In the case in question the engineer is judge, jury and

prosecuting attorney, all welded into one, and the one who usually suffers, and to whom is meted out the punishment, unless the engineer happens to be a very big man, is the contractor.

Speedy Construction Methods in Increasing Seating Capacity at White Sox Ball Park

The American League ball park in Chicago, more familiarly known as the "Sox park," covering a ground area of approximately 14 acres and having a regular seating capacity of about 29,000, has been widely heralded as the largest ball park in the world. In preparation for the recent world's series games, besides the construction of 3,000 temporary seats, it was decided to increase the permanent seating capacity by building 1,000 additional box seats around the front of the first floor of the grand stand. This made the permanent seating capacity 30,000 and the temporary capacity approximately 33,000.



VIEW SHOWING LAYOUT OF CONCRETING PLANT USED IN ENLARGING SEATING CAPACITY OF WHITE SOX BALL PARK BEFORE WORLD'S SERIES.

Rapid construction was required, as the entire work had to be completed in eleven working days. The work consisted in building four rows of box seats around the entire front of the grand stand 578 ft. in length, the construction of two new shelter houses, each 30 ft. long by 6 ft. wide, with walls 8 ft. deep, and a new front foundation footing 3 ft. deep, surmounted by a solid reinforced concrete rail 3⅛ ft. high along the entire front of the grand stand. A base for the concrete work was made back of the front footing by filling with cinders. All metal piping separating the boxes was set into the concrete and concreting was done in alternate sections to provide for contraction and expansion.

The general contract for this work was let to Standard Concrete Construction Company, 108 South LaSalle street, Chicago, who used for mixing the concrete two 1-3 yd. "the Standard" low charging mixers. Material was delivered in wagons and motor trucks and distributed along the front of the stand, leaving only enough room to set the mixers between the supply piles and the front footing. The portability of the mixers enabled them to be easily moved along, as the work advanced so that the entire operation of delivering aggregates to the mixers and the mixed concrete to the forms was accomplished by hand-wheeling the shortest possible distances.

The accompanying view shows the work in progress and illustrates how the mixers were kept close to the locations where the concrete was being placed so that manual labor was reduced to the minimum. A considerable quantity of sectional forms was required for the long front concrete rail and the shelter houses, but by moving the mixers along first to put in the footings and then to put in the floor slabs and front rail the work proceeded so rapidly that it was easily completed within the specified time limit.

Well Water Development on State Land in New Mexico

An interesting example of what water development will accomplish in the general development and material advancement of a community is found on lands owned by the state of New Mexico in Torrance county, as reported by James A. French, state engineer. These lands are leased for grazing purposes by Captain Charles L. Ballard and are known as the Ballard lease. This lease comprises 86,000 acres, and prior to an exploration for water carried out by the state engineer's department, the land was found practically valueless. The rainfall was not sufficient for farming without irrigation, and there was no surface water either for irrigation or livestock. The lessee had expended considerable amounts in drilling for water for his stock and sunk three wells to an average depth of 500 ft. without success. Thus the land was useless to the lessee and its value to the state was low. After an investigation the engineering department concluded that water would be encountered at greater depths and three test wells were sunk, under the provisions of the special appropriation for that purpose. These wells vary in depth from 700 to 1,250 ft., and in each one a flow of good water was developed, ranging from 10 to 20 gals. per minute.

With this water supply available the state land department has been able to perfect a very satisfactory lease from the standpoint of the state and to develop a revenue from land which promised theretofore to remain idle on the state's hands. The lessee is now grazing approximately 3,000 head of cattle on the land and has range capacity for approximately 6,000 sheep. The lessee has equipped these wells with both gasoline engines and windmills and has demonstrated that windmills may be used successfully for raising water from great depths. The net result of the drilling of these test wells has been to increase the grazing area of the state by the acreage of this lease, and to add very materially to the value of the land.

Convicts on Road Work

The use of convict labor on road work has met with considerable success in New York State, according to a report covering the year 1916, when three gangs from the State Prison were employed. Second Deputy Highway Commissioner Fred W. Sarr says in his report: "The use of convicts on the highway work resulted in a considerable saving to the state in both the highway department and the prison department, and it is recommended that the practice be continued, at least as long as the present stringency in the labor market continues."

In cases where the nearness of the road work to the prison permitted it, the men were taken back to the prison daily, but where the work had to be carried on at a considerable distance houses were constructed or rented at the job.

What Cities Levy Wheel Tax or License

The Editor of MUNICIPAL ENGINEERING:

Sir—Will you be good enough to send me the names of any cities which have adopted a wheel tax? We should also like to have a copy of any ordinance on this subject.

C., Albany, N. Y.

This inquiry is referred to our readers. If the entire ordinance in any case cannot be sent, kindly send an abstract of its provisions.

PAVEMENT DESIGN AND CONSTRUCTION

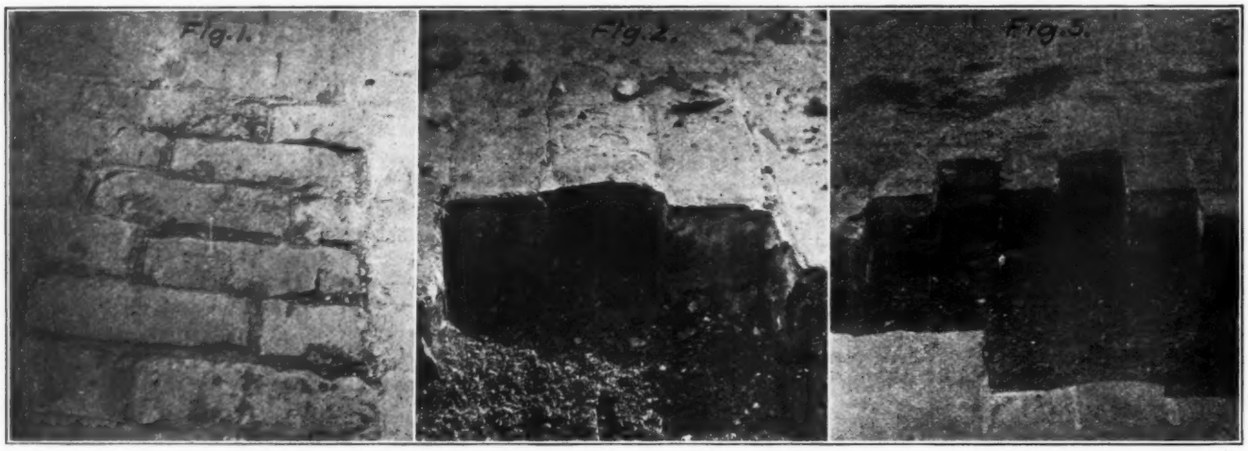
Concentration of Expansion Stresses Due to Imperfect Grouting the Cause of Brick Pavement Failures

By C. C. Wiley, Instructor in Highway Engineering, University of Illinois, Urbana.

Not infrequently defects develop in grouted brick pavements which are attributed to a failure of the foundation, shifting or shrinking of the sand cushion, or to poor brick when in reality they can be traced directly to imperfect grouting. Numerous things may cause defective grouting and thus be the ultimate source of failure, but a careful study of the failed areas will often indicate the underlying cause, the mode of failure, and means of preventing a repetition of the same mistake.

A Specific Example

The accompanying views show an interesting type of such failure. This particular spot is one of several which developed in a state aid road near Champaign, Illinois. This road is of the sand cushion type, 10 ft. in width. and was built in the fall of 1914 under the supervision of the State Highway Department. In general it is an excellent piece of work both in materials and workmanship. During the summer of 1916, however, several small "pot holes" came into evidence and with the view of ascertaining the cause of these isolated defects the writer secured permission to open some of them.



VIEWS SHOWING FAILURE OF BRICK PAVEMENT DUE TO IMPERFECT GROUTING. FIG. 1—DEFECTIVE SPOT BEFORE OPENING. FIGS. 2 AND 3—VIEWS FROM OPPOSITE SIDES OF OPENING.

Fig. 1 shows the defective spot before opening the pavement. The filler was shattered and the edges of the brick spalled off and rounded, while the adjacent surface was in perfect condition. Figs. 2 and 3 are views from opposite sides of the opening and show clearly the conditions which existed in the pavement at that point.

The sand cushion was firm and well compacted and did not extend up into the spaces between the brick. At the bottom of the joints was a layer of grout about half an inch thick at the middle of the hole, but gradually increasing in thickness towards the sides until the joints were entirely filled. On top of this was a thin layer of clay and laitance. At the top the joints were well filled to a depth of about an inch only, thus leaving the middle part of the joint entirely vacant. As already noted, the brick were badly spalled on top and in addition, one brick, as shown by Fig. 3, was badly shattered at the bottom and one or two others showed some signs of similar failure.

Normally the pressure set up by the tendency to expand is distributed over the entire face of the brick and causes no troublesome stresses. But with such a condition as here shown existing in the slab the pressure is concentrated at the edges of the brick and results in stresses which tend to spall off wedge shaped flakes from the brick. Possibly the brick may be strong enough to resist this pressure alone, but the failure occurs when it is combined with the weight, impact, and vibration of traffic.

Doubtless this defect was caused by over-running with the second application of grout. The first application was made with a thin grout which feathered out between movements of the grout boxes and was not brought up to level. The second application was made with a stiffer grout which appeared to fill the joints, but which in reality bridged over them and left the middle portion unfilled. Had the first application filled the joints practically full, this failure would not have occurred.

Disadvantages of Sand Cushion

One of the most prolific sources of trouble of this kind is the sand cushion which from various causes works up into the joints and prevents the grout from entering. For example, on a certain city street the writer found the entire surface of the pavement for a distance of about two blocks in the same condition as the spot shown in Fig. 1, while the remainder of the street was in excellent condition. Residents stated that at times in warm weather the chips could be swept up in quantities and they laid the blame to poor brick. Several openings were made in the pavement and in every instance in the affected area it was found that the sand cushion had worked between the bricks more than half the depth of the joints, while in the unaffected area the joints were completely filled with grout. Here again, the narrow belt of hard filler had concentrated the stresses of expansion at the edge of the brick and under the blows and vibration of traffic the brick had spalled and the filler shattered, making a rough, uneven and unsatisfactory surface.

Unfortunately no information was available as to the conditions under which these two blocks were laid except that the contractors' foreman stated that they often laid a block or two of brick ahead of the rolling and grouting. It is quite probable that this is what occurred on these two blocks and between the laying and grouting occurred a shower of rain which, with the kind of sand used in the cushion, would cause it to work up between the brick. The remainder of the street not receiving the shower in the same stage of construction was unaffected.

Perfect grouting is absolutely essential to the success of a grout-filled pavement and fortunately perfect grouting is not difficult to secure with a well designed pavement, suitable materials and proper handling.

The Cost of Surveying Roads in Illinois

The fear that engineering services would run into large sums of money has prevented many highway boards from employing engineers at the outset of road work. It is particularly desirable for engineers to be engaged before any work is definitely determined, because in many cases it is impossible for them to rectify errors of judgment made in laying out improvements by boards before the help of specialists was sought. Since 1913 the State Highway Department of Illinois has made over 400 preliminary surveys of roads under conditions which made the cost rather high. The roads were generally short sections and entirely disconnected, so that the cost of taking men to and from these sections was large in proportion to the amount of work done. The purpose of the survey in each case was to locate a center line for the proposed road, to locate all the features of the country affecting the proper position of the road, to take cross-sections of the ground along the route, and to obtain all information concerning draining and grade conditions. Some of the surveys were made in prairie land and some in rough country. Nearly 1,100 miles of road were surveyed in all at an average cost of $26.40. per mile. The average rate of survey was 0.84 mile per day, and the average length of each survey was 2.66 miles. As a rule, the work was done by two engineers paid $4 a day, three helpers at $2.50, a team at $3, and incidentals for transportation, board, lodging and supplies bringing the total cost the work would be for only a few miles surveyed by a private engineer, for no allowance is made for office expenses and profit. The figures are a good indication, however, of the small cost of the preliminary engineering work which should always be done before road improvements are started. The proper location of a road will not only give better drainage and easier grades, but will result in a considerable reduction in the cost of construction, because an engineer is able to locate a line in such a way that the amounts of excavation and embankment are reduced to a minimum consistent with a satisfactory highway.

Combining Brick or Granite Block with Wood Paving Blocks

The view herewith shows the novel combination of brick and creosoted wood paving block laid in alternate rows in the tracks of the Toledo Railways and Light Company, on Main street, Toledo, Ohio. This construction is attracting the attention of street railway engineers in all parts of the country.

On this work a 6-in. 100-lb. steel rail was used. A 2-in. header block was laid under the ball of the rail, providing for the tread of the flange of the wheels. A detail of the construction is as follows:

Alternate rows of Kreolite end lug wood paving blocks, and ordinary, second-hand paving bricks were used, with the wood blocks laid about ⅛ in. higher than the adjoining rows of bricks. The blocks were treated with but 6 lbs. of creosote per cubic foot of timber by the Rueping process, as it is only desirable to prevent the decay of the wood. Owing to the presence of the lugs the creosoted wood block will expand without buckling, keeping the construction permanently smooth, tight and compact. The interstices between the individual units comprising this pavement were filled with a Kreolite bituminous filler. The bricks used had already seen five years of service in the track and quite a number were shattered and broken.

This very interesting piece of track work has now been completed about six months, and the traffic has ironed it into smooth, compact, homogenous-appearing wearing surface.

ALTERNATE ROWS OF WOOD AND BRICK IN TRACKS OF TOLEDO RAILWAYS & LIGHT CO., TOLEDO, OHIO.

This method of construction, it is claimed, not only gives a greater stability to street car track pavement, but also prevents loose joints and loose rails, as the wood will continually swell, due to the absorption of moisture, through direct contact or through the humidity of the atmosphere, and thus keep the pavement solid and tight at all seasons of the year.

The wood block rows are laid a little higher than the rows of brick, so that the annealing effects of the traffic will weld the wood over the edges, preventing the cobbling of the bricks. The traffic on Main street has already proven that this advantage is well founded.

It is obvious that, in the case of alternate rows of bricks and Kreolite end lug wood blocks, the first cost of a creosoted wood block street pavement would be greatly reduced. At the same time many of the advantages of both kinds of paving material would be retained with none of their objectionable features, it is claimed. A brick pavement constructed with alternate rows of wood blocks would be transformed into a quiet pavement, while an ordinary rectangular creosoted wood block pavement would be transformed into a non-slippery, non-bleeding, non-bulging and much lower priced pavement.

The success of this type of construction in the tracks of the Toledo Railways and Light Company on Main street, Toledo, Ohio, to date promises a satisfactory solution of that long-sought permanence in paving between car tracks.

Using Labor-Saving Machinery on Road Construction in Vermilion County, Illinois

The contractors for road work in Vermillion county, Illinois, believe that mechanical equipment which saves them labor is well worth using. The cars which deliver stone to all but one of these contractors are unloaded by some mechanical device, such as belt conveyors or a clam-shell bucket used with a crane or derrick. The materials thus unloaded are hauled away on narrow-guage railways by seven of the nine

contractors. In order that there may be no delay in filling the cars on these railways or the wagons used by the contractors who do not employ railways, the materials taken from the cars are raised to elevated bins, whence they can be allowed to run down a chute into the cars or wagons. A contractor using such equipment after trying to get along with the old-fashioned hand labor method said that while the cost of handling the stone in this way was somewhat higher than by hand, he saved so much money in keeping all parts of the work moving smoothly without delays, and was so relieved from difficulties in securing enough competent labor at the unloading points that he was more than satisfied with mechanical equipment.

Conserving the City's and County's Assets by Utilizing Old Pavements as Foundations for New Surfaces

Macadam roadways in times past were a source of pride and the principles embodied in the waterbound macadam were successfully employed by many prominent engineers of the country under the conditions then existing. The macadam made a good road, although dusty at certain periods of the year, and was easy on horses' hoofs and a comfortable road to ride on.

But later, accentuated by the rapidly increasing automobile traffic, came the depressions with their accompanying jounces which set in motion the thinking apparati of many who had to travel over the thoroughfare in the pursuit of their daily livelihood, and for years engineers tried many processes to find something which would durably fill these depressions and give a passable road surface.

Repairing Old Macadam Roads

Some tried broken stone of crusher run with a sprinkle of bitumen which had very limited lasting quality. Many other methods of low first cost were tried, but none was entirely satisfactory to either the engineer in charge or to users of the road, to say nothing of the feeling of the city and town officials who had to keep feeding the road department with financial fuel to cover the constant expenditures of keeping the roads in passable condition.

There are two essentials to all good roads, no matter where built or for what purpose used, and these are: First, proper drainage, and, second, a suitable foundation. Owing to the lack of funds there are today thousands of miles of macadam roads sadly in need of resurfacing. It is a recognized fact that a macadam road will not stand up under the present modern traffic conditions. It is evidently the part of wisdom to recognize this fact, as do more and more the road officials who are insisting upon the adoption of proper drainage and utilizing as far as possible the present macadam, upon which vast amounts have been expended, as a foundation for a superior type of wearing surface.

COMMONWEALTH AVENUE, BOSTON, MASS. SOUTH SIDE—SHOWING MACADAM BEFORE PAVING WITH BITULITHIC.

LAYING BITULITHIC PAVEMENT ON OLD MACADAM FOUNDATION, SOUTH SIDE COMMONWEALTH AVENUE, BOSTON, MASS., 1916.

TABLE I—RESURFACING OLD MACADAM.

City.	Character Work.	Character Pavement	Sq. Yds.
Dubuque, Iowa	Resurface old macadam	Bitulithic	8,245
Asbury Park, N. J.	Resurface old macadam	Warrenite	11,988
Bergen & Hudson Counties, N. J.	Resurface new macadam	Warrenite	5,968
Essex Co., N. J.	Resurface old macadam	Warrenite	49,089
Middlesex Co., N. J.	Resurface old macadam	Warrenite	31,947
S. Orange, N. J.	Surfacing new macadam	Warrenite	1,160
Dallas, Tex.	Resurfacing old macadam	Bitulithic	76,684
Bridgeport, Conn.	Resurfacing old macadam	Warrenite	654,296
Brookline, Mass.	Resurfacing old macadam	Bitulithic	1,234
Dedham, Mass.	Resurfacing old macadam	Bitulithic	3,500
Fall River, Mass.	Resurfacing old macadam	Bitulithic	3,400
Franklin, N. H.	Resurfacing old macadam	Bitulithic	3,314
Winchester, Conn.	Resurfacing old macadam	Warrenite	9,151
Yonkers, N. Y.	Resurfacing old macadam	Bitulithic	18,636
Columbia Co., Ore.	Resurfacing old macadam	Bitulithic	18,921
Delta Co., Mich.	Resurfacing old macadam	Bitulithic	6,500
Escanaba, Mich.	Resurfacing old macadam	Bitulithic	16,000
Gilbert, Minn.	Resurfacing old macadam	Warrenite	15,733
Wallace, Idaho.	Resurfacing old macadam	Bitulithic	2,000
Yakima Co., Wash.	Resurfacing old macadam	Bitulithic	30,267
Total Yardage			968,032

TABLE II—RESURFACING OLD CONCRETE AND BITULITHIC ON ASPHALTIC CONCRETE BASE.

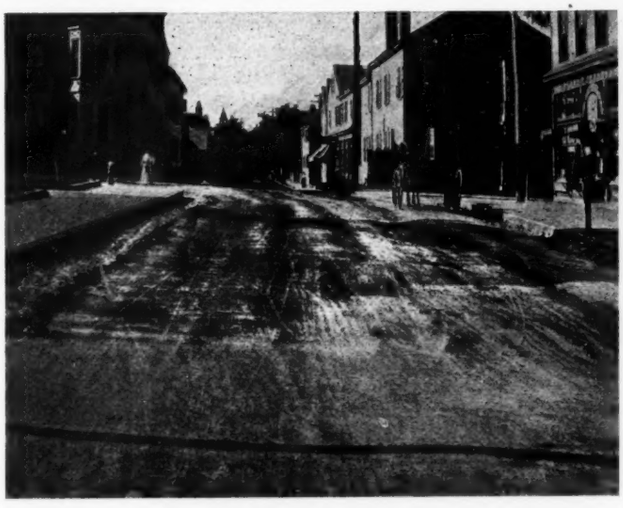
City.	Character Work.	Character Pavement	Sq. Yds.
Islip, L. I., N. Y.	Resurface old concrete	Warrenite	3,000
Clatsop Co., Ore.	Bitulithic on Asphaltic Concrete Base	Bitulithic	21,120
Portland, Ore.	Bitulithic on Asphaltic Concrete Base	Bitulithic	13,287
Walla Walla, Wash.	Bitulithic on Asphaltic Concrete Base	Bitulithic	14,904
Yellowstone Co., Mt.	Bitulithic on Asphaltic Concrete Base	Bitulithic	2,200
Idaho Falls, Idaho.	Bitulithic on Asphaltic Concrete Base	Bitulithic	15,491
Total yardage			67,022

TABLE III—RESURFACING OLD BRICK.

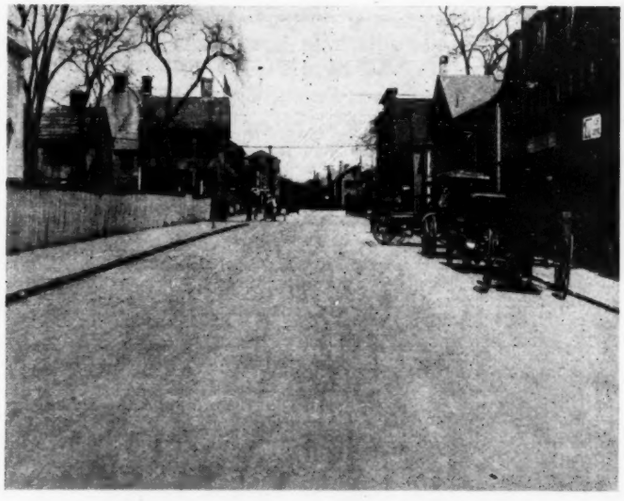
City.	Character Work.	Pavement	Sq. Yds.
Kansas City, Kas.	Resurface old brick	Bitulithic	8,990
Davenport, Ia.	Resurface old brick	Character	
Portland, Ore.	Resurface old brick	Bitulithic	3,460
Utica, N. Y.	Resurface old brick	Bitulithic	3,040
		Bitulithic	1,130
Total yardage			16,620

Putting Bituminous Surface on Old Macadam

At first those who advocated the use of the existing macadam as a foundation for a bituminous surface were laughed at or told it could not be done. After careful investigation of a macadam road upon which paving was being contemplated the officials advocated a concrete base, but it was found that, by scarifying the road, adding a small amount of crushed stone where necessary to bring the road to a proper contour and depth, and rolling it to grade, bitulithic street surface could be laid directly upon the old macadam, thus saving the city the cost of removing the old macadam, as well as the cost of new concrete foundation. This method has been tried out in many cities and counties, and they have found that bitulithic for city streets and warrenite for country roads were especially adapted for surfacing not only macadam but for resurfacing old brick or asphaltic concrete pavements which have deteriorated beyond economic use as a road surface, but available as a high class foundation for a new stable bituminous surface. This has been tried out in many places with conspicuous success; illustrations of some of this class of work are given herein.

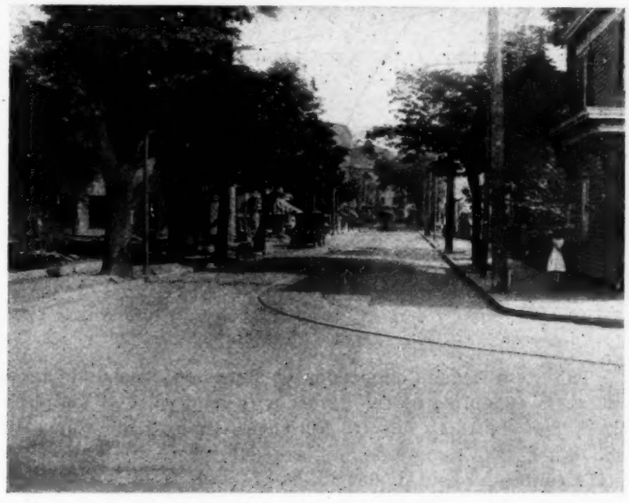


PLEASANT STREET, NEW BEDFORD, MASS., SHOWING OLD MACADAM BEFORE PAVING WITH BITULITHIC.



PLEASANT STREET, NEW BEDFORD, MASS., AFTER PAVING. BITULITHIC SURFACE LAID OVER OLD MACADAM.

RELAYING OLD BRICK ON THEIR SIDES, 1914. COMPLETED BITULITHIC SURFACE ROSE STREET, NEW ROCHELLE, IND.



BITULITHIC PAVEMENT RESURFACED OVER OLD BRICK PAVEMENT, 1914. ROSE STREET, NEW ROCHELLE, N. Y.

Lists of cities and areas of contracts which have been awarded for resurfacing city streets and country roads with bitulithic or warrenite since Jan. 1st, 1917, is given herewith in Tables I, II and III.

In the light of the advance in prices of labor and material, with naturally corresponding increase in contract prices for pavement and other construction during the last two years, it is interesting to note the effect of this period on the area of bitulithic and warrenite surfaces. Notwithstanding the advance in cost the increase of business of the nine months of the year of 1917 has been greater proportionally than during any previous year. The 1917 contracts for bitulithic and warrenite, aggregating 8,964,551 sq. yds. (including all kinds of base), is an increase of one-third over similar contracts during a corresponding period of any previous year.

This large increase has been a distinct recognition of the value of these constructions, especially in the resurfacing of macadam and other old pavements. It has been proven that the motor vehicle traffic must have a pavement surface which consists of a dense mixture which will not ravel under the suction of fast-moving rubber-tired wheels, a condition realized in the bithulithic city street pavement and the warrenite country road surface.

Items to Be Considered in Selecting Pavements in Toledo

The city of Toledo, Ohio, is in the midst of plans for the most extensive group of paving and repaving jobs ever undertaken there at one time. Many sections of the city are affected by the proposed improvements, and several thousand residents are directly interested in the work.

It is especially important, therefore, at this time, that careful consideration be given to the kind of pavement best adapted for each particular street and the standards that should be used in making the selection of materials. H. C. McClure, commissioner of engineering and construction, recently issued a statement to the citizens calculated to enable them to choose paving materials wisely.

The average citizen who is interested enough to attend a public hearing on the subject of a particular pavement has acquired some idea of the kind of pavement he would like to have laid, but rarely is his notion based on a definite knowledge of the qualifications that pavement should have. Frequently the only factor he wishes to consider is the cost. He wishes a material selected that will entail the smallest possible initial expense. Many times, on the other hand, this factor is made subordinate to durability, or perhaps maintenance cost.

But it is extremely rare that a property owner has taken into consideration all the factors that are necessary in pavement selection. For that reason Table I was prepared by Mr. McClure, suggesting the qualities that should govern the selection of pavements and their relative order of importance for various classes of districts.

TABLE I—SUGGESTED LIST OF ITEMS TO BE CONSIDERED IN THE SELECTION OF PAVEMENTS FOR TOLEDO, AND THE RELATIVE ORDER OF IMPORTANCE OF EACH FOR VARIOUS CLASSES OF DISTRICTS.

Order of Importance.	Office Building and Retail Stores District.	Wholesale Ware house and Dock or Railroad District.	Boulevards and Expensive Residential District.	Medium and Cheaper Residential Districts.	Thru Traffic Thorofares All Districts.
1.	Noiselessness.	Durability.	Appearance.	Appearance.	Durability.
2.	Appearance.	Tractive Resistance.	Durability.	Cost.	Tractive Resistance.
3.	Sanitariness.	Ease of Maintenance.	Sanitariness.	Durability.	Slipperiness.
4.	Durability.	Slipperiness.	Ease of Cleaning.	Sanitariness.	Appearance.
5.	Ease of Maintenance.	Sanitariness.	Noiselessness.	Ease of Maintenance.	Ease of Maintenance.
6.	Ease of Cleaning.	Appearance.	Slipperiness.	Ease of Cleaning.	Noiselessness.
7.	Slipperiness.	Ease of Cleaning.	Tractive Resistance.	Noiselessness.	Cost.
8.	Tractive Resistance.	Noiselessness.	Cost.	Slipperiness.	Sanitariness.
9.	Cost.	Cost.	Ease of Maintenance.	Tractive Resistance.	Ease of Cleaning.

PAVEMENT CLEANING AND MAINTENANCE

Cost of Highway Maintenance Work in Maryland

By H. G. Shirley, Chief Engineer, Maryland State Roads Commission, Baltimore, Maryland

The State Roads Commission of Maryland consists of three members appointed by the governor to hold office at his pleasure. The chairman devotes his entire time to the work and the other two commissioners are subject to his call. The state contains about 17,000 miles of road, from which there has been selected a state system, consisting of about 10 per cent., and it is estimated that from 75 to 80 per cent. of the traffic in the state is carried by the 10 per cent. selected. Practically all of this 10 per cent. has been completed, and there is a continuous connected highway starting at the Pennsylvania line on the west through the entire state to Ocean City on the east. There have been completed about 1,500 miles of state and state-aid roads in the state, outside of the roads the counties have built on their own initiative. These 1,500 miles of roads connect every county seat with the others and with Baltimore city. Types of construction vary with the local conditions and availability of materials. Quite a large amount of concrete, bituminous materials on a concrete base are now being used. The work is done under the supervision of the chief engineer, and under him there are seven resident engineers who occupy seven residencies, which comprise the whole state. These men are located at the most convenient points in their residencies, and have charge of all construction and maintenance therein. The patrolman system of maintenance is used, and very satisfactory results have been secured.

Up to the present time there has been expended $24,000,000, including about $6,000,000 in Baltimore city for paving north-south and east-west routes, and erecting a large bridge across the harbor. A close study of traffic is made, and the wear on the surface of roads is determined as carefully as possible. It is estimated that a certain amount of traffic will wear off a given amount of surface, and it is the object of the commission to replace just a little more surface than wears off each year. Everything is estimated on the per ton per mile basis, and we find that the average cost of maintenance throughout the state is $.004 per ton per mile. We find the highest cost of maintenance in the thinly settled sections of the state, where it runs as high as $.008 per ton per mile, whereas on

some of the roads near Baltimore city, where the traffic is 2,500 tons per mile per day, the cost runs $.002 per ton per mile.

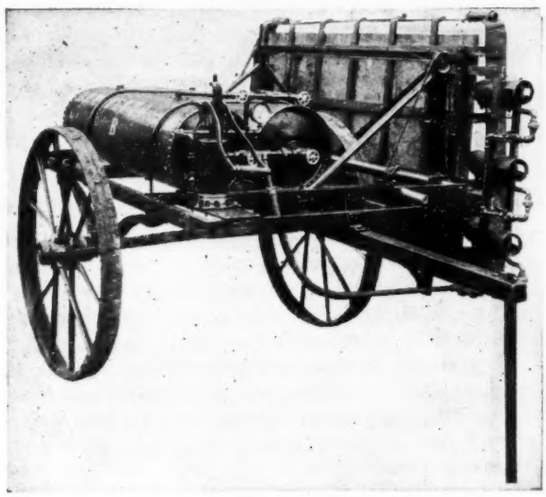
Improved Methods of Resurfacing and Patching Asphalt Streets in Detroit

By A. C. Proctor, Asphalt Expert, Department of Public Works, Detroit, Mich.

In spite of our heavy automobile traffic we have had a surprisingly small amount of asphalt street repairing to do, even on asphalt streets which have been down for as long as 30 years.

Effects of Motor Vehicle Traffic

Our oldest streets were not intended to bear their present heavy and continuously steady automobile and motor truck traffic. At the time they were laid we knew nothing concerning present conditions. Since that time, however, Detroit has grown into the largest automobile center in the world. Not only have we the greatest manufacturing production of cars and trucks, but our streets carry the heaviest traffic in this line.



TRACK SURFACE HEATER DESIGNED TO OPERATE CLOSE TO STREET CAR TRACKS WITHOUT INTERFERING WITH TRAFFIC.

New regulations affecting parking of cars and "safety spots" for people waiting for street cars have diverted this tremendous traffic into such narrow confines at this junction that all automobile and trucks travel in the same track. The constant grind and tear of tires, instead of being more or less evenly distributed over an area of pavement surface, is therefore directed into two narrow strips, which gradually develop into a depression or rut, a condition which up to the present time has developed only in a small area, possibly about three ordinary blocks.

New Methods of Repair

In the repairing of these worn strips we have developed a new method which is much more satisfactory and economical than the old method of chopping out.

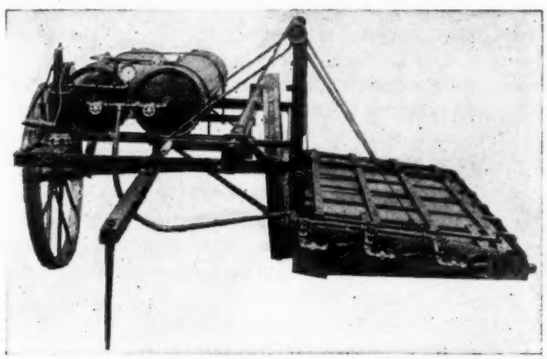
In working out this solution we have worked in close conjunction with the manufacturers of the "Pluto" asphalt surface heating machine, the Chausse Manufacturing Company of Detroit, with the result that we have perfected a machine which meets all of our requirements in a speedy and satisfactory manner. We had so far used this machine almost exclusively in the repairing of asphalt pavements, but its use should prove equally satisfactory in the resurfacing of old brick and cobble pavements with asphalt. Two views of the machine are shown herewith.

This machine, which has a heating hood measuring 6x6 ft., or 4 sq. yds., equipped with a battery of six "Chausse" burners, carries 53 gal. of kerosene oil in two tanks. The auxiliary tank feature is an excellent one, as it is never necessary to shut down operations on account of tank filling. The main tank holds 35 gal., while the other tank carries 18 gal. When one tank is emptied the operator merely switches to the other, and immediately fills the tank which has already been emptied. The surface heater is equipped with six burners to the battery. Each burner consumes approximately 1 gal. per hour.

The track surface heater is so designed that it may be operated close to car tracks without interferring with traffic. It folds like a jack-knife and is readily portable. This outfit has a battery of three "Chausse" burners with a heating capacity of 18 sq. ft. in three to five minutes.

Cost and Performance Data

In the completion of approximately 80,000 sq. yds. of asphalt repairing the surface heater reduced the cost from $1.22 to 97c per sqare yard. Two men and one of these machines will do the work of four men chopping out in accord-



TRACK SURFACE HEATER WITH HOOD LOWERED READY FOR OPERATION. OTHER VIEW SHOWS FOLDED UP READY FOR TRANSPORTATION.

ance with old methods, but we are saving 1 in. of asphalt and 1⅛ in. of binder to boot. Hand-chopping meant that everything was taken out right down to the base. The machine has shown a capacity for heating sheet asphalt surface for proper handling to a depth of 1 in. on 400 sq. yds. per eight-hour day, although it has handled 600 sq. yds. in an eight-hour day under ideal conditions. Aside from the saving of 1 in. of asphalt top and the 1⅛ in. of binder, the machine speeds up the work in that it also saves the handling of this material.

A similar machine, especially designed for repairing ruts made in the pavement by the continual travel of automobiles and trucks in the same path, is 6 ft. long by 9 in. in width. This machine, which is easily handled by one man, has a capacity in heating asphalt surface for proper handling to a depth of 1 in. on 72 sq. yds. per eight-hour day. This special machine has two burners and is equipped with an 18-gal. kerosene tank. One man and one of these machines easily do the work of four men who were formerly employed in chopping out.

Drying Old Pavement for Asphalt Resurfacing

When using an old pavement of asphalt block, brick or granite as foundation it must be absolutely clean, with all moisture driven out by heat, so that the paint coat, of a proper consistency, which binds the wearing surface to the foundation, will adhere. The apparatus used in drying these old pavements is the 6-ft. by 6-ft. heater. If there are any loose integral parts they should be removed and the foundation

brought to grade by filling all depressions with a close asphalt binder, rammed and compacted, or, if deemed advisable, the old brick, if in good condition, could be filled. Foundations of this class should only be used on a street or road of light or medium traffic.

Significance of Data Collected in Iowa Road Census

Some surprising information concerning the use of roads in several Iowa counties has been obtained by a traffic census which is being carried on by the Iowa State College and State Highway Commission. The census is by no means complete, and the results obtained up to the present time may be materially modified by later information. They show, however, that the travel over Iowa roads is of a character that makes the improvement of such roads a matter requiring careful thought and sound judgment.

Data Taken at Eight Stations

The following facts relate to the travel counted at eight stations on highways leading into market towns of considerable importance. These roads are known as tourists' highways, yet the census shows, unexpectedly, that only 3 per cent of the traffic could be classed as tourist. The counts were made during the tourist season and should put to rest the assertion that road improvements are mainly for the advantage of people who make no payment of taxes toward the cost of the betterments. As a matter of fact, the great bulk of the traffic, 87 per cent, was between towns, what would be called interurban traffic by electric railway companies. The traffic from farms along the roads amounted to only 10 per cent of the total.

Interest of Towns in Country Roads

Attention is called to this distribution of the traffic because it emphasizes the fact that towns and cities have a direct interest in road improvements. Where more than three-fourths of the travel over main roads originates in towns along those roads, as is the case in the Iowa highways which have been under observation, it is self-evident that the expense of road improvement should not be borne mainly by the farmers, as at the present. The principle of rate-making for most classes of public service is that the charge for the service should be based on the use made of it. Road improvements form a class which heretofore has generally been exempt from the application of this principle. If more traffic enumerations are made like those in progress in Iowa, the injustice of putting most of the expense for improvement of market roads on farmers will lead eventually to a change in this policy.

Ratio of Motor to Horse Traffic

It has been known for some time that there are more automobiles in Iowa, in proportion to the population, than in any other state. The returns from the traffic census show that these automobiles are being used very frequently. They are not pleasure vehicles, for Sunday excursions. If the returns which included July 4 are thrown out because of the unusual traffic on that day, the proportion of motor vehicles to horse vehicles using the roads ranges from 2 to 1 on one road to 18 to 1 on another road. The average proportion at all eight stations, including the counts made on July 4, shows that eleven motor vehicles were used to one horse vehicle. It was also observed that these roads were carrying an average of 387 vehicles daily. When it is considered that this traffic was carried on dirt roads, as a rule, it is evident that the construction and maintenance of Iowa roads with the funds available for the purpose is a very hard problem to solve satisfactorily.

Motor Trucks and Earth Roads

One of the most instructive features of the census returns is the information regarding the use of motor trucks. On one road there were five horse-drawn trucks for every four motor trucks, the lowest proportion of the latter at any of the census stations. On one road there were 2.6 motor trucks for each horse truck and on another road there were 3.3 motor trucks for each horse truck. The average of all the stations was 1.1 motor trucks for each horse truck. It goes without saying that this proportion will be changed during the season when heavy trucking is being done from the farms to the market towns. It is expected that the proportion of horse trucks to motor trucks will be much higher then. Motor trucking has come so rapidly into favor among farmers, and trucking companies in cities are sending so many trucks into the country to haul agricultural products to market, that it would be surprising if the returns of traffic during the heavy hauling period do not show that motor trucks are rapidly becoming essential for the farmer.

This fact adds to the difficulties of maintaining dirt roads, such as are so numerous in Iowa. While something can be done by regulating the loads and speed of motor trucks to reduce their destructive influence on dirt roads, there is no form of maintenance, so far as is now known, which will keep a dirt road in good condition when many motor trucks are operated at more than very moderate speed over it. It would be interesting and instructive to determine the effect on dirt and gravel roads of trucks operated at different speeds, for it is possible that speed may be found the most important factor in determining the destructive effect of such vehicles. If this should prove the case, road officials will have a means of controlling the destruction of their low-cost roads until they are able to secure the funds for the construction of surfaces better adapted for such traffic.

Increase in Motor Traffic Makes for Flat Road Crowns

So long as earth roads were used only by horse-drawn vehicles there was no serious objection to giving them a high crown in order to shed the rainwater which fell on the roadway to the side ditches as quickly as possible. Now that such roads are used by automobiles the conditions are quite different. The best dirt roads are slippery in wet weather if they contain much clay. Skidding into side ditches is a dangerous occurrence. During June of this year two persons were killed and a large number were injured in Iowa by such accidents. The Highway Commission of that state has recently made public the following comment on the subject, in connection with some notes on an important main highway:

"Blade grader outfits have put it to natural grade, tho the cross-section for most of the distance shows altogether too steep an incline from center to side ditch. A terrific downpour of rain for half an hour between Delman and Charlotte made it almost impossible to stay out of the ditch. The passing of half a dozen cars encountered before dry road was reached again was a perilous undertaking, but, barring the steep slope, the blade grader work was well done and the road is in fine shape."

This practice of heavy crowning is particularly dangerous where the dirt roads are maintained by oiling, a method of maintenance which is growing in favor in Iowa. An oiled dirt road is considerably more slippery than a plain dirt road, when wet. It is evident, therefore, that dirt roads which are used to any extent by automobiles should have only enough crown to shed the water. Such a requirement also makes it necessary to maintain the roads in good condition by dragging and oiling under certain local conditions, in order that they may not become soggy in wet weather. While the expense of such maintenance might be considered unnecessary, in part, if a greater crown is used, the fact is that an unnecessary crown always leads to higher maintenance expense than is necessary with a road having the best cross-section. A high crown tends to concentrate the traffic along the center of the road and develops ruts and holes in the surface there.

Resurfacing Roadways with Tar-Macadam Cold-Mix

By John S. Crandell, C. E., Formerly Professor of Highway Engineering at the Pennsylvania State College.

A few years ago a cut-back tar was developed by one of the tar producers for the purpose of making repairs to bituminous, macadam and concrete without the necessity of heating the materials constituting the patch. The advantages of a cold patching material are obvious, and the cut-back tar met with instant favor.

Procedure in Using Cold Mix

The manner of using it is as follows: About 18 gal. to 20 gal. of cut-back tar are mixed with a cubic yard of crushed clean stone. This mix is set aside and allowed to cure for a

PATCHING WITH TARVIA K. P. IN JACKSON CO., MO.

few days. By the end of a week's time the more volatile oils have evaporated and the mix has begun to set up. It is then taken to the places on the road where it is needed. The spots to be repaired are dug out, making the sides perpendicular so as to prevent the patch from being crowded out of the hole by passing traffic. The mix is put in place, thoroughly tamped and a seal coat of the cut-back tar is painted over the new surface, which is given a dusting of sand, pebbles or screenings, and traffic admitted.

The whole operation is simple and repairs can be made quickly and easily by one man. On rainy days he can make up the mixture and store it away for future use.

Experience at Millersburg, Pa.

In 1916 the road authorities of Millersburg, Pa., went a step further and resurfaced part of an old and badly worn macadam with a 2 in. top made of local stone and cut-back tar (Tarvia Kold Patch).

PILE OF STONE AND SAND MIXED WITH TARVIA K. P. CURING.

The street is 30 ft. wide between curbs, and only the middle 16 ft. strip was treated. Results would have been better if the entire width had been resurfaced and if the thickness of the new top had been more nearly uniform. But, as it is, the experiment was very successful, and except for two or three spots where the mix was too "fat" the new top is in very good condition. The whole work was done by hand, which accounts for a lack of uniformity in the mixture.

Experimenting in Ohio

The State Highway Department of Ohio is at present experimenting with the cold tar mix for resurfacing in Franklin county and at Urbana. The ruts and depressions in the road are first patched with the mixture of stone and Tarvia Kold Patch, then the road is swept. A paint coat of K. P. is applied to the entire road surface. On this mixture of stone, sand and Tarvia K. P. is spread to a depth of 2½ in. and rolled. When the rolling is completed a seal coat of Tarvia K. P. is applied, and the new top is covered with pea gravel. The road is allowed to set up for two or three days before traffic is turned on.

The mixture is made in a concrete mixer. Various proportions of ingredients have been tried. The one that seems to give the best results consists of 1 cu. ft. of sand. 4 cu. ft. of crushed stone, 0.36 cu. ft. of Tarvia K. P. These are mixed for one full minute and the mixture is then dumped in a pile, as shown in the illustration. This pile looks like a heap of chestnut anthracite coal. A tarpaulin covers it in wet weather. At the close of day a quart of kerosene is put in the mixer with a couple of shovels full of stone and revolved a few times to clean out the tar and tarred stone.

This method of laying tar concrete appeals very strongly to contractors because of its simplicity, and also because the gang can be kept at work rain or shine. While it is raining, large stores of the mixture can be made up, and if enough is accumulated the entire gang can be put on the road in good weather to use up the excess produced. When made in large quantities and stored in large piles the mix can be laid after several weeks' storage.

In order to hasten the setting up action the Ohio State Highway Department is trying the experiment of spreading the newly mixed material in a 2 to 3-in. layer on the tar-painted road, keeping traffic off, and rolling after about two days' time. This method has the disadvantage that during the

MIXER, MIXING PLATFORM AND MATERIALS USED WITH TARVIA K. P.

interim it may rain. While the rain itself cannot injure the mix, which is waterproof *per se*, it may cause mud or clay to find its way from the old roadbed into the new material.

The mixer that is being used is manufactured and sold by the Jaeger Machine Company of Columbus, Ohio, at $440. The cut-back tar which conforms to the Ohio state specification is Tarvia K. P., furnished by The Barrett Company.

Leads World in Wealth.

The per capita wealth of the United States is $2,030; that of Great Britain, $1,751; of France, $1,522; Germany, $1,355. Our present national debt is $33 per capita, or will be after the $1,800,000,000 war budget is passed; that of Great Britain, $370; France, $360; Germany, $290. We could pay our debt 169 times over without being "broke." We have $25,000,000,000 of "liquid" money, subject to check, in our bank deposits. Our trade balance in 1902 was $478,000,000; in 1916 it was $2,000,000,000, a 500 per cent. increase in fourteen years.

The Improved System of Road Maintenance in Washington

By George F. Cotterill, Chief Engineer, Washington State Highway Commission, Olympia, Wash.

An important feature of our work this season was the production of bulletin No. 9, entitled: The Rules, Regulations and Requirements for the Maintenance of Primary Highways as Prescribed by the State Highway Board.

Prior to this year, 1917, the primary state highways, which had been constructed by the state, were being directly maintained by the State Highway Department from a state appropriation therefor which had gradually increased to $75,000 annually, but which was notoriously inadequate. Had that system been continued the maintenance fund would at least have required to be doubled. Instead of doing that, the state legislature of 1917, in its wisdom, took all maintenance away from the State Highway Department and imposed it on the several counties, providing for an apportionment to the counties of the motor vehicle license revenue—now reaching $500,000 per annum and increasing—for maintaining the constructed primary state highways within their borders, and also a certain class of improved main county highways. The aggregate mileage of primary state highways subject to this maintenance is about 1,500 miles, and the improved main county highways to which this fund is also applicable exceeds 3,000 miles as a total.

The state legislature, however, made requirement that the maintenance of these constructed primary state highways by the county authorities should be "under such rules, regulations and requirements as may be prescribed by the State Highway Board." The law also provides for enforcing the prescribed standard of maintenance if counties become delinquent.

Bulletin No. 9 embodies these maintenance rules, regulations and requirements, which have been in effect since June 7, 1917. The department had no maintenance specifications or prescribed standards from other states to draw from, hence this is "new matter" drawn from our experience and judgment as to methods, standards and cost reports of highway maintenance. We are now four months on our first year of this dual system of state-prescribed, county-executed maintenance. It seems to be working out well, but judgment as to its ultimate wisdom must be suspended, at least until we have gone through an entire year, and especially our winter, or "rainy season," of western Washintgon.

Road Reconstruction and Maintenance in Rhode Island

By Irving W. Patterson, Chief Engineer, State Board of Public Roads

The work of the State Board of Public Roads of Rhode Island was handicapped somewhat this year by the high prices which prevail. Our funds this year were appropriated solely for reconstruction and maintenance. Our main trunk lines have been practically completed for several years, but a great many miles of the older construction are wholly inadequate to withstand the traffic to which they are subjected today. Reconstruction and maintenance are our big problems.

Perhaps the most interesting feature of our reconstruction work is the attention paid to foundations. As a rule the state roads of Rhode Island are subject to a year-round commercial traffic. In the winter and early spring the use of heavy commercial vehicles makes imperative heavy foundations. Our construction work this year has been almost wholly bituminous macadam. This type of construction has given us very good satisfaction where sufficient attention has been paid to foundations and drainage. Heavy stone fills and an "insulating" cushion of coarse sandy, gravel are laid wherever the soil conditions are deemed bad enough to warrant it.

Maintenance of Waterbound Macadam

The maintenance of our waterbound macadam roads is almost a hopeless task. Few of these roads were designed for the heavy traffic which they are called upon to carry today; many of them are so old that they have outlived their usefulness, and the erratic method of financing maintenance work in the past has had its usual accumulative effect. Upon those roads completely worn out and upon those roads which lack the necessary foundations we have not spent large amounts for maintenance, working upon the theory that it is preferable to set aside all that we possibly can for reconstructing these roads in a permanent manner as rapidly as possible.

Maintenance of Bituminous Macadam

The maintenance of our bituminous macadam roads is carried out wholly by section gangs equipped with a light tandem roller, heating kettles and the necessary small tools. We find that a patrolman's work upon bituminous macadam construction is somewhat limited by reason of lack of equipment necessary to repair in a permanent manner large cuts made for the purpose of installing public utility structures, such as gas pipes, electric wires, sewers, etc. Equipped as they are, our section gangs are capable of doing very effective maintenance work, even reconstructing short sections of road which have failed.

To date no actual construction work has been done under our Federal Aid Road Act. We have recently executed the project agreement for our project No. 1. It is expected, therefore, that construction work will follow in the very near future.

The Concrete Type of California State Highway

The California State Highway Commission has developed what may be called its standard type of pavement, consisting of a relatively thin concrete base covered and protected by a thin bituminous wearing coat. The concrete is laid without expansion joints and upon a well consolidated subgrade.

Mone than nine-tenths of the expenditure for the pavement is placed where the traffic has little chance of destroying the investment. The bulk of the road cost goes into the grading, drainage appliances and a solid concrete foundation. The wear and tear of traffic does not come in contact with this foundation, as the concrete is protected by a surface coat of asphalt and mineral aggregate. Such a coat is easily applied and gives a high return in wearing qualities for its cost. This wearing coat does not roll or form ridges and hollows. It adheres firmly to the concrete pavement, and at the end of three or four years it may be renewed by a new coat of asphaltic road oil and rock screenings.

The oldest concrete roads built by the commission have been protected by the thin bituminous wearing coat for nearly four years, and the maintenance cost has been very low.

Judicious Use of Machinery and Dynamite Lowers Road Grading Costs

A contractor on a Pennsylvania road has completed his work at a lower cost than was attained on other sections of the road by using machinery to an unusual extent. On account of the high price of labor and its scarcity in that section he used a steam shovel in all cuts, low-strength dynamite to loosen the material and speed up the work of the shovel and automatic dump wagons to remove the earth and shale as it was excavated. The outfall drainage ditches were blasted out with dynamite, thereby reducing the cost of excavation and trimming the slopes. The work was finished on time in addition to being done at a relatively low figure, for the conditions, while the other contractors were unable to finish on time on account of the difficulty of securing labor to carry on the work by the older methods utilizing merely plows, scrapers and hand work.

WATER WORKS DESIGN AND CONSTRUCTION

Design and Construction of 1,500,000-Gallon Reinforced Concrete Reservoir

By H. F. Blomquist, City Engineer, Mankato, Minn.

In the design of a reinforced concrete reservoir of the type here described there are some features upon which designing engineers differ in opinion, said Mr. Blomquist, in addressing the Minnesota Surveyors' and Engineers' Society. The present discussion dwells more on these features than on the general design of the reservoir.

Special Features of Design

The reservoir is built on a hill composed of red and blue clay. The floor is about 17 ft. below the original ground line and filling around the walls extends to the height of the high-water line, which is about 8 ft. above the original ground line.

Special attention is called to the following features of design:

1. The circular plan compared to rectangular or square.
2. The amount of horizontal reinforcement in the walls and the consideration given the earth pressure on the walls to offset the tension due to the inside water pressure.
3. The conical roof, compared to a flat slab.
4. Expansion joints between floor and walls.
5. The provisions made for cleaning.

Economic Plans

Where a reservoir is built entirely in solid ground it has been found that the thrust of the outside earth against the walls is sufficient to counteract the water pressure on the inside, and therefore no reinforcement is necessary in the walls when the reservoir is filled. Under such conditions a square or rectangular plan will somewhat reduce the cost of construction because of less expensive centering.

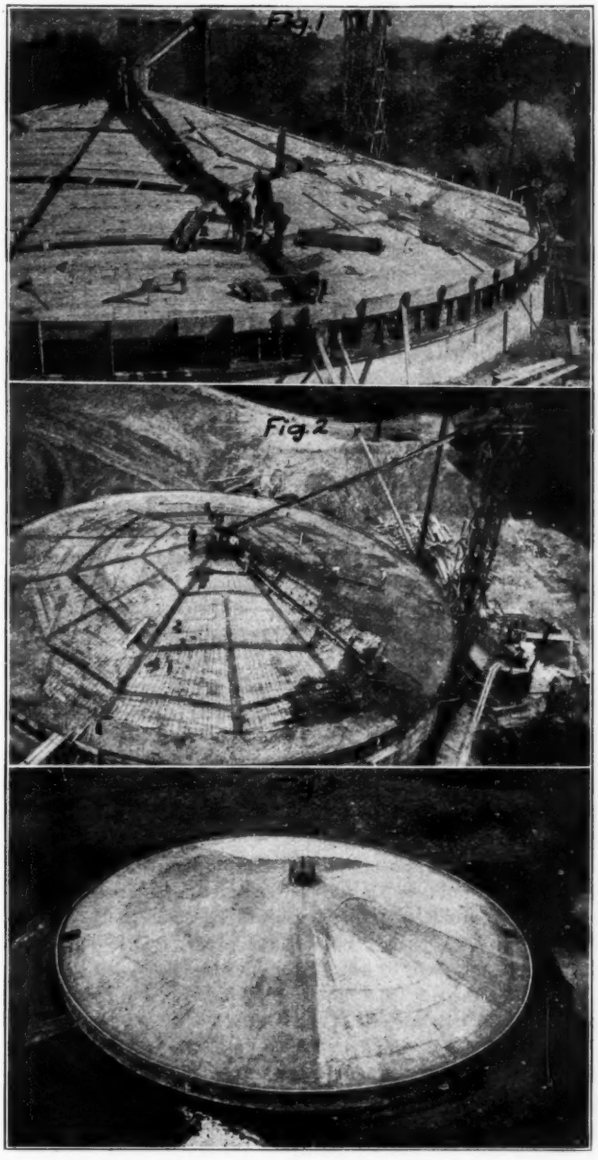
However, when the reservoir is empty the earth pressure on the outside will create stresses in the walls opposite to those caused by the inside pressure when filled. For this reason reinforcement is necessary to take care of this negative stress, unless some other means is provided, such as a gravity wall or other form of construction. Under these conditions a circular plan will not require horizontal reinforcement or other means of overcoming negative stress when the reservoir is empty.

If horizontal tension in the walls is to be taken care of by reinforcement, the circular wall requires the least amount for a given internal pressure. It will also counteract the thrust of the outside earth against the walls when the reservoir is empty without producing tension in any part of the walls. It may be said in passing that the outside thrust against the walls in some instances may be very large, especially if the earth has been saturated by water from leakage or other causes.

The circular types of construction cost more than the square or rectangular for the same amount of wall, but the saving in reinforcement and in volume of concrete or masonry is sufficient to offset the difference in cost; therefore I believe the circular plan is the better to adopt in all cases where space will permit its use.

Roof Design

Where a covering over a reservoir is desirable, the cheapest construction, if concrete is used, undoubtedly is a flat slab; it may, of course, have pitch to provide proper drainage. The method of supporting the roof will depend on the depth, size and shape of the reservoir. If the reservoir is not deep, a large number of pillars from the bottom will reduce the size of beams, and vice versa. To find the most economical construction, each case must be studied by itself. There will always be a certain length of span at which the cost of construction will be the minimum, such a condition that by either increasing the length of spans and size of beams and decreasing the number of supports, or by decreasing the length of span and increasing the number of supports, will result in an increase of cost. The most economical condition must be found by trials and estimates in each case.



CONSTRUCTION VIEWS ON MANKATO RESERVOIR. FIG. 1—POURING THE ROOF BEAMS. FIG. 2—POURING THE ROOF. FIG. 3—ROOF JUST COMPLETED, GROUT SURFACE WASH NOT YET FINISHED.

There are instances, however, when economy must give way to some other desirable features. Too little attention has been paid in this country to the aesthetic features of permanent structures. In the use of concrete the general appearance of a structure may be greatly improved at very little cost above a strictly economical design. This, however, is a question outside the scope of this article.

Having given some consideration to the aesthetic side of the result, the most desirable covering was a conical shaped concrete roof supported by reinforced concrete beams inclosed with a curtain wall above the top of the wall proper. The roof rests on the outside walls and seven pillars, placed one in the center and six in a circle 60 ft. in diameter around the center pillar, making the longest beams 30 ft. in horizontal length between centers of supports.

The roof slab is 4½ in. in thickness, being 4 in. of 1:2:4 concrete and ½ in. of mortar coating troweled to a smooth, hard finish. The roof slab is reinforced with ⅜-in. steel rods, 8-in. centers, laid one way only, and with a network of steel wire netting consisting of 4-in. mesh with double No. 8 wire longitudinally and No. 12½ crosswise. The amount of reinforcing is sufficient to carry a loading of 100 lbs. per sq. ft. of surface, besides its own weight. The roof beams are so arranged as to place them about 12 ft. apart.

In the design of the roof slab no consideration was given to the arch action of the slab due to the conical shape of the roof. This is a variable amount at different places of the roof, and while it would be sufficient to consider in calculating the amount of reinforcement, it was not taken into account; its value will, therefore, go toward increasing the factor of safety.

Reinforcing

The necessary amount of horizontal reinforcement in the walls and the value of the earth pressure or thrust that may be safely taken to neutralize the stress due to the inside water pressure will, of course, depend on the nature of the ground and the care exercised in filling around the walls after the forms are removed. With care in refilling the clay soil, this earth thrust ordinarily is more than sufficient to counteract the pressure due to water extending from the surface of the ground to a given point in the wall. There would, however, be certain times when the upper layer of the earth, say the surface layer about 6 ft. thick, would not act as a support to the walls, because during very dry conditions of the ground contraction takes place in it, so that it recedes from the adjoining surfaces; this is also true in very cold weather when the ground is dry and freezes.

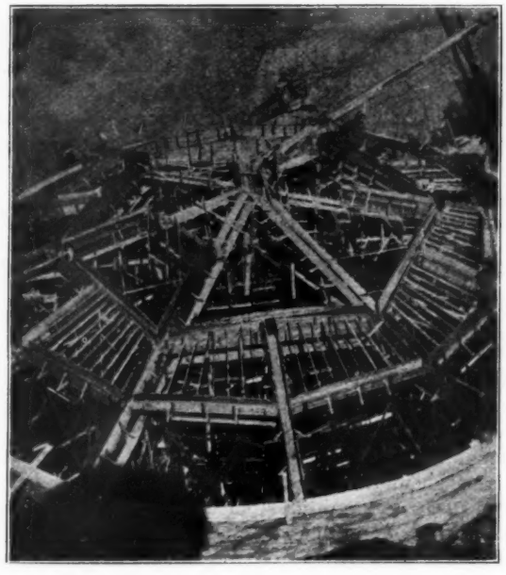
For this reason, no support from the filling or upper 6 ft. of the ground surface should be assumed. In our design the horizontal reinforcement in the upper 15 ft. of the wall is sufficient to take the entire tension due to the inside water pressure at a unit stress of 16,000 lbs. per sq. in., with a surplus amount near the top to take care of ice thrust in case of ice formations on the water. The reinforcement in the lower 10 ft. of the walls is not sufficient to take all the tension at 16,000 lbs. as a unit stress. About 40 per cent of the tension is here assumed to be taken up by the outside earth thrust, and with no tension being assumed in the concrete it is safe to assume the design has the proper factor of safety.

The floors consist of 10 in. of concrete reinforced with ⅜-in. rods laid both ways, 9 in. apart. The floor was constructed after the walls and roof had been completed. A ¾-in. expansion joint connects the floor and walls, also the floor and pillars. This joint was caulked with oakum and filled with an asphalt filler. The floor slopes from the wals toward the center, being 18 in. lower at the center than at the walls.

Methods of Construction

On account of the firmness of the ground it was intended to trim up the sides after the excavation had been made, so that no outside forms would be necessary for the walls below the surface of the ground. The hard rains during the time of excavation caused some slides to occur, so that forms were needed for about half of the walls.

After the excavation had been completed the forms for the entire walls and the six large roof beams radiating from the center, also the supports for the centering of the roof, were built before any part of the wall, except the foundation below the floor line, had been poured. The reinforcement was placed in the wall at the time of building the forms, and was supported by two 2-in. angles laced together for this purpose. These supports rested on the concrete foundation already poured for the walls, and were placed at intervals of 10½ ft. and carried the entire horizontal reinforcement. These angle supports, together with ¾-in. rods 2 ft. apart, form the vertical reinforcement of the walls.



VIEW OF SUPPORTS OF MANKATO RESERVOIR ROOF FORMS.

All the concrete for the entire structure, except for the foundations and the floor, was distributed from the hopper at the center of the roof, the radiating forms for the roof beams acting as chutes to different points around the wall.

The mixer was placed in a pit below the surface of the ground near the wall and the concrete hoisted in a tower about 60 ft. above the surface of the ground, from which it was run thru an inclined chute to the hopper at the center of the roof.

All the material was on the ground before pouring of the walls was commenced, because they were to be poured in a continuous operation to avoid horizontal seams forming where concrete would set between pourings if done intermittently. The sand and crushed stone were taken from the material bins to the mixer in dump cars.

The pouring of the walls was done in four days and four nights, without stopping the mixer at any time for more than one hour, and the concrete deposited at different points around the wall in rotation, so that no part of the surface had set before new concrete was added.

Small openings in the forms were left for working the concrete in the walls to prevent voids, and these were closed up as the filling progressed.

The walls are 24 in. thick at the bottom and 15 in. at the top. After the walls had been completed, the forms for the roof baems were cleaned and completed and the centering laid for the entire roof slab before the beams were poured. The

centering for the roof slab was all supported by staging from the bottom. The form work, centering and supports for roof beam and slab required about 100,000 ft. of lumber, but the greater part of this did not require cutting, and therefore the waste was not more than about 15 per cent.

The reinforcement was then placed in the beams and all the beams and curtain wall poured. After the beams were completed the reinforcement was placed for the roof, and the concrete afterwards poured. The concrete was mixed sufficiently stiff to prevent sliding or running when placed on the inclined roof, which has a rise of 15 ft. in 50. The roof slab was finished with a ½-in. mortar surface troweled to a hard, smooth finish.

The mixture of the concrete in the foundations is 1:2:5, and of all the walls, roof and floor is 1:2:4. Crusher run limestone passing a 2-in. ring was used for the coarse aggregate. As an aid toward water-proofing the concrete in the floor, walls and roof slab, 20 lbs. of hydrated lime were used with each barrel of cement used, the lime being first thoroly mixed with water.

For water-proofing the concrete surfaces two plastering coats were applied, consisting of 1 to 2 cement mortar, to which was added Trus-Con Water-proofing Compound, and then the surfaces given a brush washing of cement grout.

Provisions are made for draining out all the water in cleaning, and since there is a separate system of water supply for the hill district, 4-in. pipe line from this system was laid into the reservoir and provided with a 2½-in. fire hose nozzle, so that a fire stream of 60 lbs. pressure may be used for cleaning.

The reservoir has been in use about two months and no visible leakage has so far taken place.

The work was done by the J. B. Nelson Construction Company, of Mankato, under contract, at a cost of $19,373.

The new reservoir is used in conjunction with the old masonry reservoir of about 800,000 gals. capacity, and was constructed primarily for the purpose of increasing the storage capacity of the water works system for fire protection.

Construction Plant and Methods Employed in Building the Nepaug Dam of the Hartford Water Works

By H. W. Griswold, Assistant Engineer, Hartford (Conn.) Water Works

The contract for the masonry for Nepaug dam and appurtenances, together with about one-half mile of highway, was awarded to Fred T. Ley & Co., Inc., of Springfield, Mass., in March, 1914, and was completed by them in July, 1917.

Dam Section

The dam was built largely of cyclopean masonry with a maximum height above the surface of the rock of about 130 ft. and a length of 600 ft. In section it is 20 ft. wide at the top, 90 ft. wide at the bottom and is curved upstream to a radius of 390 ft. An overflow section was built in the center of the dam, the highway being carried over it on a series of 5 concrete arches, each having a span of 36 ft. The overflowing water falls down a series of steps into a pool lined with concrete, rubble masonry and paving at the base of the dam. The difference in elevation of the surface of the water in this pool and that in the reservoir is 100 ft. An inspection gallery, 7 ft. by 5 ft., entered from the lower gate chamber, runs parallel with the axis of the dam near the upstream face and from this gallery seepage wells are carried down to rock and up to reservoir flow line.

Construction Railway

For the transportation of material and supplies for the construction it was necessary to build a mile of standard gauge railroad up the Nepaug ravine to the damsite from the New Hartford branch of the New Haven railroad. The grading for this spur was done with a ¾-yd. steam shovel, and a portable boiler and steam drill for the rock work. As soon as steel was laid on the spur, a commissary and bunkhouse of the usual type were built and the construction of the cofferdams and flume begun, said Mr. Griswold in addressing the annual convention of the New England Water Works Association.

The Cofferdams

The upper cofferdam was about 150 ft. upstream from the axis of the dam, the lower 175 ft. downstream from the axis, and both were of the rock-filled crib type, with tongue and groove sheet piling and toe-fill on the river side. The flume was built along the foot of the west slope and was framed and planked as suggested on the contract drawings. This flume was removed as soon as the two central blocks of the dam were built above the river bed, and thereafter the river was diverted through a 10 x 10 ft. culvert in one of the blocks with a flume from the downstream face to below the lower cofferdam. In filling this culvert with concrete, after the dam was completed, the part between the upstream face and the inspection gallery was first poured, the water being carried around this section in a small by-pass which had been left in the concrete. This by-pass was next filled and then the remaining section down stream from the inspection gallery was poured and the whole closure grouted to insure watertightness.

Excavation

Excavation was started with the steam shovel as soon as grading for the spur track was finished, the excavated material being hauled by train to a spoil bank in a side valley about one-fourth mile below the damsite. Earth at the top of the east slope by team to spoil bank below the dam, at the top of the slope, and material (largely sand) on the east slope was sluiced down to the steam shovel below with a fire hose. The same method was tried on the west slope, but was not successful, and the excavation there was completed with pick and shovel.

The underlying rock, a mica schist with numerous pegmatite dykes, had a dip of 45 degrees to the west, so that the east slope showed comparatively smooth ledge, while the rock on the west slope was very irregular. Just east of the river was a ridge of fairly sound rock, and between this and the foot of the west slope, under the bed of the river, was an area of hydrated mica schist, which had the unpleasant characteristic of disintergrating into a sort of blue mud on exposure to the air in the presence of water.

Practically none of the dam is built on the original surface of the rock, it being necessary to excavate from 2 to 30 ft. before rock suitable for a foundation could be found. The upper part of this excavation was done by drilling and blasting, and the balance by barring and wedging. Spoil was handled by derricks and skips into cars.

A suitable foundation being secured, the next step was to make a water-tight cutoff in the rock, 10 to 20 ft. wide, near the upstream face by forcing grout under pressure into the seams of the ledge. That a practically water-tight cutoff was secured for the full length of the dam is shown by the very small leakage through the seepage wells with the reservoir within 6 ft. of being full.

Laying Out the Work

The method of laying out the work is of special interest, as nearly every surface of the dam is curved in at least one direction. The upper part of the downstream face of the non-overflow section is curved both vertically and horizontally. The method used, which worked out very successfully, was devised largely by G. W. Penfield, who was in charge of the field party, and consisted primarily of a dual system of rectangular and polar co-ordinates. The origin of polar co-ordi-

nates was at the center of the sweep of the dam, the axis of which was curved to a radius of 390 ft. and over this point a 40-ft. tower for a transit station was built. A base line was run up the valley from this tower, and a second base line, with concrete monuments at either end, was run at right angles to the first and tangent to the axis of the dam. From these base lines the rectangular co-ordinate system was extended as needed. All monuments were set by rectangular co-ordinates and checked by triangulation, the monuments at the ends of the east and west base line and the origin of polar co-ordinates forming the primary triangle. In laying out face forms, the expansion joint lines on either side were first given from the tower and the intersection of the face form with these lines obtained by measuring a computed distance along the expansion joint lines from their intersection with an east and west rectangular co-ordinate line. Curve of form between expansion joints was given by ordinates from the eighth points of a chord, formed by pulling a line between the points on the expansion joints. Batter and radius boards were also used in checking and truing up forms.

Concreting

In general, forms were built of 2-in. lagging with 2 x 6-in. studs on 2-ft. centers and 4x6-in. rangers. To save time in erection, lagging was cleated into panels 8, 10 and 12 ft. long. Forms were wired to plume stones or pins set in concrete.

The cement used for concrete work was tested at the mill and on the job. Storage was provided for 60 cars, or 10,000 bbls. Crushed trap rock was shipped from the quarry at Tariffville in bottom dump, steel gondolas, from which the stone was dumped directly into the bins. Bin capacity was 2,000 cu. yds. stone and 1,000 cu. yds. sand and stone for plums and heavy riprap was quarried in the same valley. Sand was obtained from a glacial deposit in the valley used as a spoil bank. Boulders, picked out of the river with a locomotive crane, were also used for this purpose.

Concrete was mixed in two 1-yd. Ransome mixers served by skip cars running in a tunnel under the bins. There was a wooden tower for each mixer, but both towers dumped into the same chute. Chutes were suspended from derrick guys or cables put up for that purpose.

Placing Concrete in Form

The method of placing concrete in the form was a new wrinkle which worked very successfully. It consisted of bringing the end of the main chute to a 30-ft. gin pole, fitted with two horizontal booms with a swinging radius of about 270 degrees. The upper boom was about 20 ft. long and the lower 10 ft. long. By suspending two 10-ft. sections of chute, one from the end of the main chute and the tip of the lower boom, and the other between the lower boom tip and a trolley running along the upper boom, concrete could be placed at any point within the swing of the upper boom. A 3-ft. square box was built around the gin pole and the resulting hole in the concrete was filled up the next time concrete was poured in that block.

Before placing concrete on the rock foundation the latter was washed perfectly clean with a hose stream, all loose rock removed and the whole surface covered with grout, put on with a fire hose under about 80 lbs. pressure. It was then plastered with mortar which was worked into all large cracks and holes.

The surface of each day's run of concrete was broomed or scraped with hoes the morning after it was laid, and before fresh concrete was placed it was thoroughly washed and broomed with grout. A crushed stone drain was laid between seepage wells to intercept seepage on a day's work joint. The expansion joint seepage wells were closed with concrete blocks, and the whole surface plastered with mortar. We then placed 1:3:6 concrete in 1-ft. layers, beginning at the downstream face. Along the upstream face a richer mixture (1:3:5) was used for a width of about 3 ft. No drawboards were used. Plum stones were cleaned with a hose stream on the cars and placed by derrick. In forms where chutes could not be used concrete was placed with 2-yd. Haines buckets. About 375 cu. yds. was an average day's work with chutes, and bulkheads were built where necessary to give a depth of from 6 to 8 ft. for a day's work.

In addition to the plums which stuck up above each lift, a key 6 in. deep by 3 ft. wide was left at the upstream face, and usually a section 4 to 6 ft. wide along the downstream face was left 6 in. higher than the rest of the run.

Sidewalks, the roofs of the gate chambers and tops of parapet walls were trowel finished, spillway steps were floated and sides of parapet walls and all panels were rough pointed. The downstream face of the non-overflow portion was sand blasted.

Cost

The cost of the work was approximately half a million dollars, and the following is a list of the principal quantities: Earth excavation, 35,000 cu. yds.; rock excavation, 20,000 cu. yds.; refilling and embanking, 17,000 cu. yds.; cyclopean masonry, 75,000 cu. yds.; mass concrete, 4,000 cu. yds.; concrete surfaces finished, 40,000 sq. ft.; Portland cement, 80,000 bbls.; large cast iron pipe and special casting, 40 tons; metal for reinforcing concrete and for waterstops, 100,000 lbs.; miscellaneous cast iron, wrought iron and steel, 35,000 lbs.

WATER WORKS MAINTENANCE AND OPERATION

Procedure in Maintenance and Operation of McPherson, Kans., Water and Electric Plant

By Arthur Groesbeck, Superintendent Water and Electric Department, McPherson, Kans.

The management of a municipal public utility, even in the small city, is largely an engineering problem. The manager of the small city utility cannot often call in expert engineering assistance and the first requisite of a good manager of such a utility is that he have knowledge of engineering.

Reorganization

Prior to 1914 the city of McPherson had the council form of government consisting of a mayor and eight councilmen. The water and electric department was placed under the management of a water and light commission of three men, appointed by the council, and they in turn hired a chief engineer who had charge of the powerhouse, an electrician who had charge of the lines, a cashier and a collector. All the work for the water department was turned over to the plumbers, without specifications as to how the work should be done. Each plumber had a different way of setting meters and installing services. They also repaired meters, or attempted to, and at least 50 per cent. of the meters were under-registering. The only records of the plant operation were the invoices of coal and supplies, and no attempt was made to keep a cost analysis of the production.

The water and light commission was abolished in September, 1913, and a superintendent appointed to take charge of the department. As can be imagined, his was no easy task, but he succeeded in getting rid of several superfluous employes, including the chief engineer, and hired a very competent man for this position. The superintendent was reappointed by the commissioners, but resigned in a short time, and the writer was appointed in August for the unexpired term.

Looking Into Operating Conditions.

In looking over the books the operating expenses seemed to be out of proportion to the output of the plant. The chief

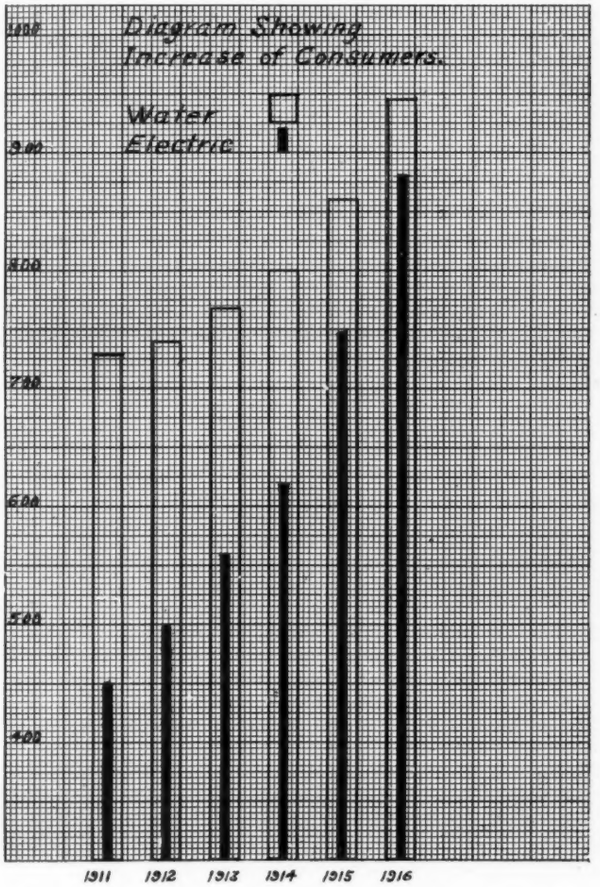


FIG. 1—INCREASE IN CONSUMERS, McPHERSON, KANS., WATER AND ELECTRIC PLANT.

engineer had designed a station log and was endeavoring to keep records of the operation of the plant. He was not having much success, as this necessitated a great deal more labor on the part of the engineers, and as they had not been in the habit of doing more than keeping up steam and the machinery oiled, they did not take kindly to his orders. They even informed him that they were hired by the commissioners and expected to take orders only from them. A notice from the manager's office that the department was out of politics and that their jobs depended on their ability and willingness to do the work required of them had the desired effect of bringing them into line.

In order to attack the problem in a systematic manner an inventory of the operating conditions was taken. Were the boilers clean? Were the boiler settings tight and the furnaces in good condition? Were the firemen using the proper draft and were they using the dampers instead of the ash pit doors, thus reducing excess air? Were they using the best method of firing? Were the blow-off valves tight and used properly? Was the feed water heater clean and giving maximum temperature? Were the combustion chambers clean and the tubes free from soot? Were all the exposed steam lines covered? Were the engines and pumps operating at maximum economy? Were the valves properly set?

Improving Boiler Room Efficiency

The word *No* answered all these questions. After removing the scale, some of which was over half an inch thick, it was necessary to restubb the tubes, but this item of expense was very small compared with the cost of fuel that had been wasted due to this scale. After cleaning the boilers and heater we used a cheap chemical fed continuously into the heater and

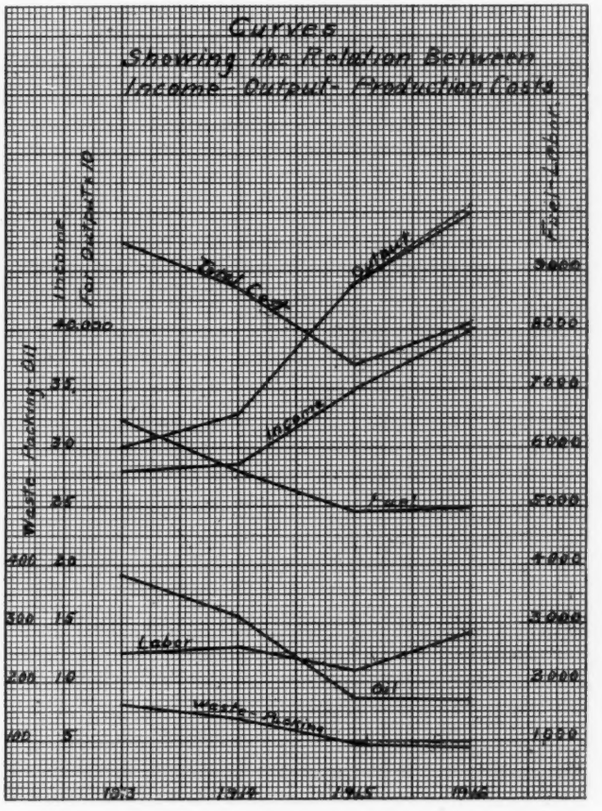


FIG. 2—CURVES SHOWING RELATION BETWEEN INCOME, OUTPUT AND PRODUCTION COSTS, McPHERSON, KANS., WATER AND ELECTRIC PLANT.

our boilers today, after over two years operation, are free from scale. The boiler settings were in such shape that the inrush of cold air would draw out the flame of a candle at nearly every point where it was applied. The settings were repaired and painted with two coats of asphalt which has proven to be an excellent remedy for leaky boiler settings. The firemen were instructed as to the best method of firing and the proper use of the dampers. It is very hard to induce a fireman to change his way of firing, but we accomplished this by running tests with different methods and giving the firemen the results of the tests. Pipe covering was purchased and all the steam lines covered. We also purchased an indicator and by using it regularly are enabled to keep the valves properly set. A recording steam gage gives us constant steam pressure instead of the previous variation from 60 to 145 lbs. and a recording volt meter in the manager's office greatly improved the voltage regulation of the system. Scales were installed in the boiler room and the coal is now all weighed and checked against the output for each shift. After making these changes one boiler easily carried the load where previously it had required two.

Going After New Business.

We were then ready for new business, and the first step along this line was a reduction in the rates and a power and cooking rate of 4c was established. We began our advertising campaign for electrical cooking in December, 1914. The services of a very competent demonstrator were secured for a week to demonstrate the ranges, as we felt that this was the only

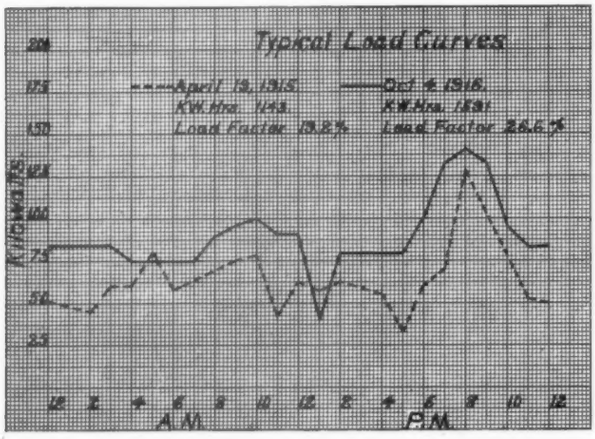


FIG. 3—TYPICAL LOAD CURVES, McPHERSON, KANS., ELECTRIC PLANT.

way of getting the proposition before the public and of showing the many advantages of the modern way of cooking with electricity as compared with the old way. Approximately 500 people attended our demonstration and eight ranges were sold during this week.

In connection with our advertising campaign we secured several reels of moving pictures, which were run at the theaters free to the public, showing the many disadvantages, trials and tribulations of the housewife cooking with coal, and the comfort and happiness afforded by changing from the old-fashioned way, with all its dirt, soot and delay, to the clean and economical method of cooking with electricity. We used considerable space in the daily papers, circulated hand-bills over the entire city, and used inserts in mailing out our monthly bills.

As the cooking load is very essential to us for the improvement of our load factor, it is continually being solicited by means of advertising and personal work of our employes and also by the local dealers handling the ranges. When houses are wired we impress upon the owner the importance and necessity of having provision made for an electric stove and other electrical appliances which he cannot afford to do without.

New Rate Schedule

On January 1, 1916, a new rate schedule went into effect, giving another reduction in light and water and also in the cooking rate. Ordinances were passed defining in detail the policy of the department and were published in booklet form. We have had numerous calls for these ordinances and feel flattered that they have been adopted by other cities. We also passed an ordinance requiring a license and a bond from all persons doing electrical wiring in the city. All wiring is inspected and must pass the code before connection is made with our system. Our customers receive the benefit of this as we have obtained lower insurance rates on several buildings by having the wiring brought up to code.

Operation Data

Fig. 1 shows our increase in consumers from 1911 to 1916. The increase of electric consumers in 1915 is due largely to the low power and cooking rate, and the increase in 1916 is the result of the reduction in rates and our campaign for new business.

Fig. 2 is a collection of curves showing the relation between income, output and production costs from 1913 to 1916. One will note here the effect of stopping leaks in the plant had on the cost of production. The cost of fuel, oil, waste and packing has been reduced in spite of the fact that the output has increased 66 per cent. and the income 43 per cent.

Fuel Expense Reduced 22 Per Cent.

Fig. 3 is another way of showing in a graphical manner how the income was expended in 1913 and 1915.

Fig. 4 shows two typical load curves and gives at a glance the effect of a range and motor load. From midnight to 6 in the morning the load is fairly constant and consists principally of street lighting and the pumping load. The greater part of the leak at 10 a. m. is due to ranges, as one will notice; this drops off in the afternoon to a constant load till 5 p. m., when the ranges are again started to prepare supper.

Fig. 4 shows the method we use in comparing our outppt and cost of production from month to month and from year to year. One will notice that as the output increases the unit cost decreases and this is one reason we are so anxious to build up our day load.

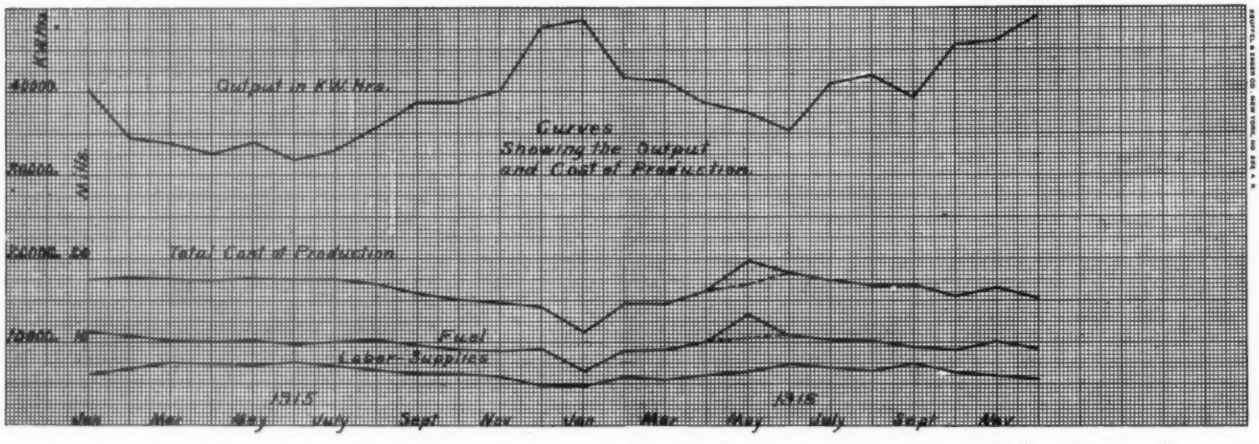


FIG. 4—CURVES SHOWING OUTPUT AND COST OF PRODUCTION, WATER AND LIGHT PLANT, McPHERSON, KANS.

Curves similar to these, tables and pictures are published in the city's annual report. We strive to publish a report that is readable and it is our desire that every citizen will read the report. In this way he knows what we are trying to do, will take an interest in the department and takes pride in boosting for us.

We are proud of the things we have accomplished with municipal ownership, yet realize that we have done nothing any other plant cannot do if the same remedy is applied, namely, take the department entirely out of politics, place it on a business basis and give the management to an engineer-business man with this one restriction, that he must get results.

The sharp increase in the cost of fuel shown in the diagram, Fig. 4, for May, 1916, was due to several cars of very dirty and poor coal received at that time. By our system of plant records we were able to convince the coal company of this fact and they rebated us so that the actual fuel cost is represented by the dotted line.

Plant Improvements in 1917

Since the first of the year we have entered into contracts for a new generating unit, consisting of a Skinner Universal Uni-flow engine direct connected to a 312 KVA General Electric generator. The necessary switch-board panels and instruments are included in this contract. The new boiler-room equipment will consist of a 250-h.p. water-tube boiler, feed-water heater and boiler feed pumps. We are making a departure from the usual practice of boiler setting and are setting this boiler so that the distance from the grates to the heating surface will be a minimum of 7 ft. We will make quite a fuel saving and will obtain practically smokeless combustion. We have just completed a 125-ft.x5-ft. concrete chimney and a 300-gal. per minute deep well with pump head and driving motor. All of these improvements will be paid for from the earnings of the department. When these improvements are made we will have the largest station of any city this size in the state.

Extending Light Lines to Farmers

In order to extend the benefits of municipal ownership we are building transmission lines into the country to supply the farmers with light and power. We have one line built and contracts signed for another line 6 miles long, and are now working on estimates for a line to one of the smaller towns near here.

Using Permanent Concrete Covering to Prolong Life of Steel Pipe

On a California pipe line 10,000 ft. of 24 in. steel pipe used in inverted siphons working up to 80 ft. head, after 30 years of use, was giving away at places and called either for replacement or repair. In other places the steel had pitted badly. It was necessary to shut down and put concrete bands on the pipe to prevent the sudden failure, which was imminent.

Forms

Cylindrical concreting forms, swung from A frames, were placed around the pipe preparatory to casing it with a shell of reinforced monolithic concrete.

Forms were made of Oregon pine and, where particularly smooth surface finish was required, were lined with 26-gauge sheet metal. Forms were made in 8-ft. lengths where the clear diameter of pipe covering was 24 in. For 14 and 18-in. diameters forms were made in 12-ft. lengths. The work was done as follows:

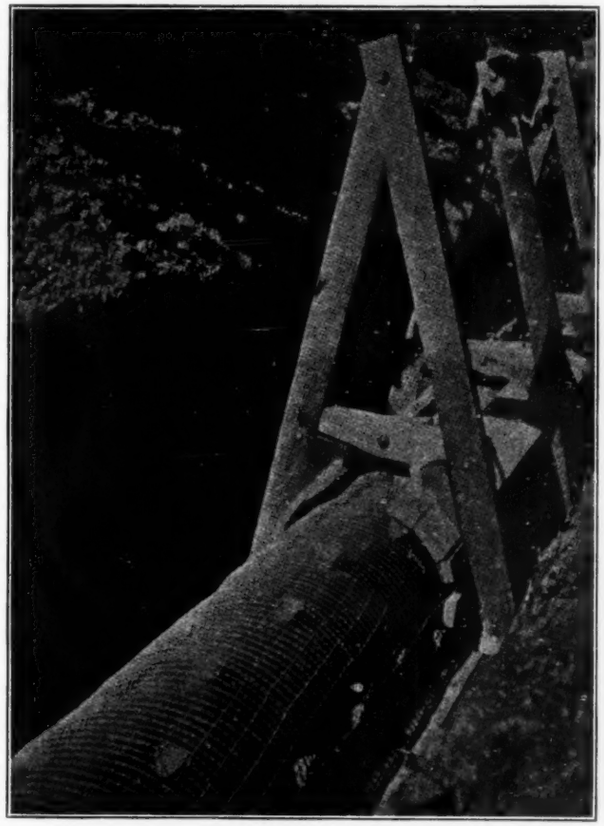
The steel pipe was uncovered and thoroughly cleaned with steel brushes. The ground under the pipe was shaped properly and 2x4's were spaced and bedded on each side to support the forms as shown herewith.

Reinforcing

Wire mesh in convenient lengths was then wound spirally around the steel pipe which was used as the inside form. Mesh was held the required distance from the pipe by precast concrete blocks made in the form of trunacted pyramids 1½ in. high, about 2 in. square at the base and ¾ in. at the apex. The apex was placed next to the pipe while the mesh rested on the base of the pyramid. These blocks were hand cast by a man operating a hand mold that made 4 blocks at a time. In 9 hours it was possible to turn out between 2,500 and 3,000 such blocks. As blocks were placed, the edges of the reinforcing fabric properly lapped were tied together with soft iron wire.

Concreting

Forms were then set up and filled with a rather wet concrete mixture consisting of 1 part cement, 2½ parts sand and 1 part crushed rock, graded up to ¾ in. Concrete was hand mixed. When depositing, it was worked to place and properly consolidated by puddling with a small rod and by constant



VIEW OF FORMS AND REINFORCING USED IN CONCRETE COVERING AN OLD STEEL WATER PIPE.

tapping on the sides of forms. The following day forms were removed and the concrete given a coat of neat cement paint. Following this it was covered with dirt and kept wet for ten days to insure thorough and uniform hardening.

A gang of 12 on this work proved that 100 ft. of 24-in., or 130 ft. of 18-in. or 160 ft. of 14-in. pipe could be covered as described in a day of 9 hours. At the time this work was done, labor cost from $2.25 to $2.50 per day. Cement cost $2.30 per barrel on the track, sand $1.50 per cubic yard, broken stone 80 cts. per ton plus hauling. The wire mesh used on this work cost 6½ cts. for No. 10 and 12 wire and 4 cts. for No. 12 and 14 wire per square foot, woven in 1 x 2-in. mesh. The heavier wire in each case ran longitudinally and the light wire laterally.

Cost

The cost of the work, exclusive of excavation, was $1.14 per running foot for covering 24-in. pipe. This cost compares with two alternatives that were offered—replacement of the old pipe line by using 12-gauge steel at $1.36½ per foot, exclusive of hauling, and $1.50 per foot for precast reinforced concrete pipe, exclusive of hauling. The cast-in-place work, therefore, showed a desirable economy.

SEWER DESIGN AND CONSTRUCTION

Using Air Compressor on Varied Trench Work in New York City

By C. L. Edholm, Engineer, 68 West Ninety-seventh Street, New York City

Getting under the skin of Manhattan is a difficult job, as the digger of trenches in the city streets has learned. The average man knows it, too, for he is the one who is forced to pick his way around excavations where an underground structure is being installed. The contractor knows it best of all, for his profits depend upon the speed and thoroughness with which he can pierce the tough skin of the city and patch it up again.

Increasing Use of Air Compressors

So it is a matter of interest to all parties concerned to observe the increasing use of the air compressor in trench work, which lightens the labor, cuts the cost and shortens the time of excavations in the streets. Not only is the work completed with much greater speed, thus lessening the inconvenience to the general public, but the cost of doing the work is enormously reduced, cut to one-fifth, or even one-seventh, of the previous expense of trenching.

Cutting Asphalt Pavement

From the very first step the air compressor is in evidence. The asphalt pavement is cut along the lines of the proposed ditch by hammer drills, and the concrete base upon which it rests is handled by the same rapid fire implement. Before the portable air compressor had come into common use the method employed was exceedingly slow and laborious: One man would hold the long, pointed chisel known as the "bull point" against the tough surface, while two big-muscled laborers would drive it in with sledge-hammer blows.

Now a man with a Sullivan hammer drill speedily tears off the asphalt surface, while a second driller follows a few yards after him and attacks the tough concrete, which a shovel man throws out of the ditch. The foundation may run

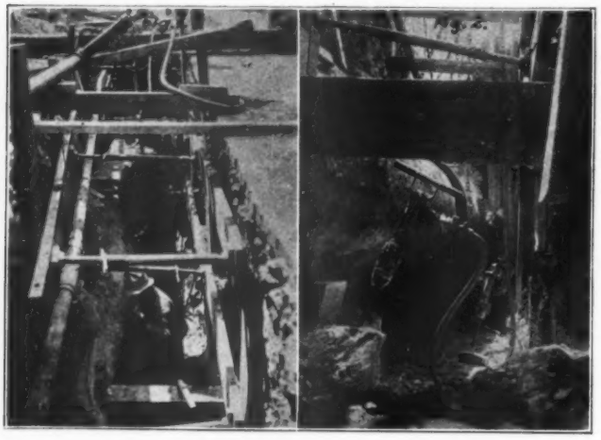


FIG. 1—DRILLING ROCK FOR BLASTING, BROADWAY, NEW YORK. FIG. 2—JACKHAMER DRILLS IN BOTTOM OF SUBWAY TRENCH IN BROADWAY.

from 4 in. to 1 ft. in depth, and for a small subway that may mean one-half of the depth in the latter case.

The cost of this operation is cut to one-third or one-fifth by the present method, hence it pays to put air compressors on the job for breaking the pavement, even though the soil underneath requires no drilling.

Using the Jackhamer

In case rock is encountered below the concrete, the "jackhamer" is put to use, at an average saving over hand-drilling operations of 86 per cent. With this apparatus, small and easily handled with a tripod, a hole may be run from 6 in. to

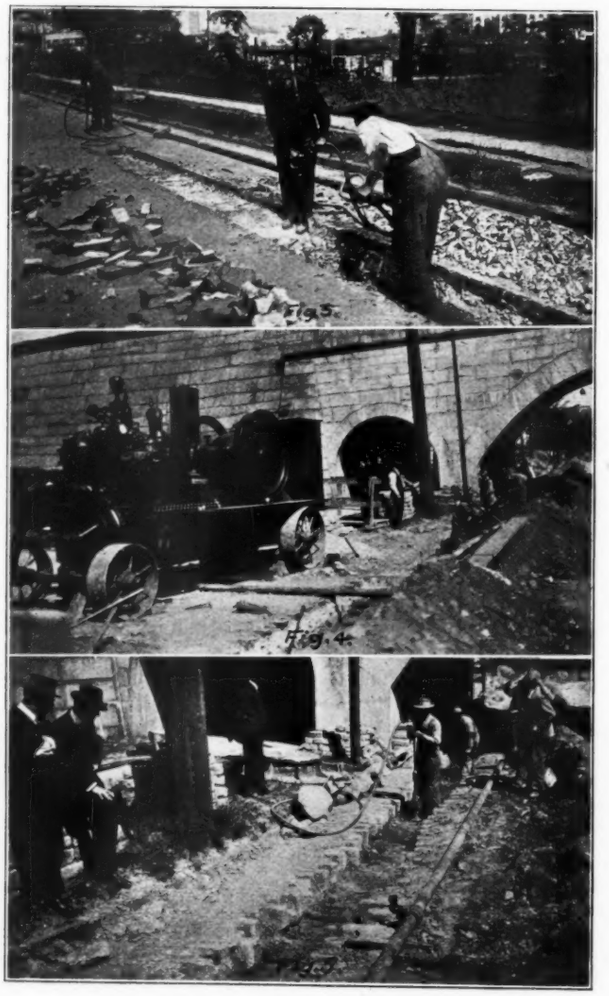


FIG. 3—SULLIVAN HAMMER DRILLS CUTTING ASPHALT BLOCK PAVEMENTS AND CONCRETE BASE. FIG. 4—CHICAGO COMPRESSOR SUPPLYING PNEUMATIC RAMMERS IN TRENCH. FIG. 5—INGERSOLL-RAND PNEUMATIC TAMPING MACHINE RAMMING BACKFILL IN TRENCH.

6 ft. and of a diameter ranging from 1 1-16 in. to 1¾ in. Cutting the cost of drill holes for blasting to one-seventh is a great saving, and when one adds the saving of overhead charges that result from shortening any job of contracting, such as salaries of engineers and executives, clerks, watchmen, etc., the results are even more impressive. The saving to those who use the streets, merchants who deliver goods, freight

handlers who do heavy hauling and the owners of other vehicles for business use or pleasure, can only be guessed at, but undoubtedly every day saved in street excavation is big money saved for the public that uses the thoroughfare.

The last step of trench work is the filling of the excavation and tamping the soil preparatory to repaving. This is often an unreasonably slow operation, though under the old method of tamping by hand there was some ground for delay, as it was useless to pave upon soil that was not thoroughly settled. The present method makes use of a pneumatic tamper that does the work in a hurry, but does it right.

The Crown Floor Rammer

For this purpose the machine known as the "crown floor rammer" is utilized, an application of compressed air that was devised for use in foundries, where it was employed in ramming sand in the casting room. Their availability for tamping was discovered and made use of, so that today from start to finish the street excavation employs the air compressor.

The development of the air compressor in the last few years has been rapid, and yet it is still being perfected, the present demand being for a machine which is light and easily transported, yet capable of supplying the 50 to 75 cu. ft. of free air per minute required to run a jackhamer. The gasoline-driven compressor seems to be the most desirable for trenching on any job that requires shifting of the machine at intervals. Hand drilling and steam drilling for trench work are practically obsolete, except where a steam line can easily be taken off of a steam boiler on a trenching machine. For jobs on which the machinery can remain in one position for some time the electric-driven compressor is economical and efficient.

Gas-Driven Portable Compressor

The Empire City Subway Company, Ltd., which handles subway contracts for the New York Telephone Company, makes use of four of these gas-driven portable compressors. They range in size from a 27 h. p. machine, with a capacity of 150 cu. ft. of free air per minute, to a very small one of from 3½ to 5 h. p. of 24 cu. ft. per minute capacity. The latter is easily moved by two men, weighs but 1,200 lbs., and like the larger sizes is mounted on wheels for easy transportation.

The photographs herewith show the various tasks of the hammer drills, jackhamers and tamping machines on the streets of New York or beneath them, and suggest that without their aid the big problem of getting under the skin of Manhattan would be almost impossible of solution.

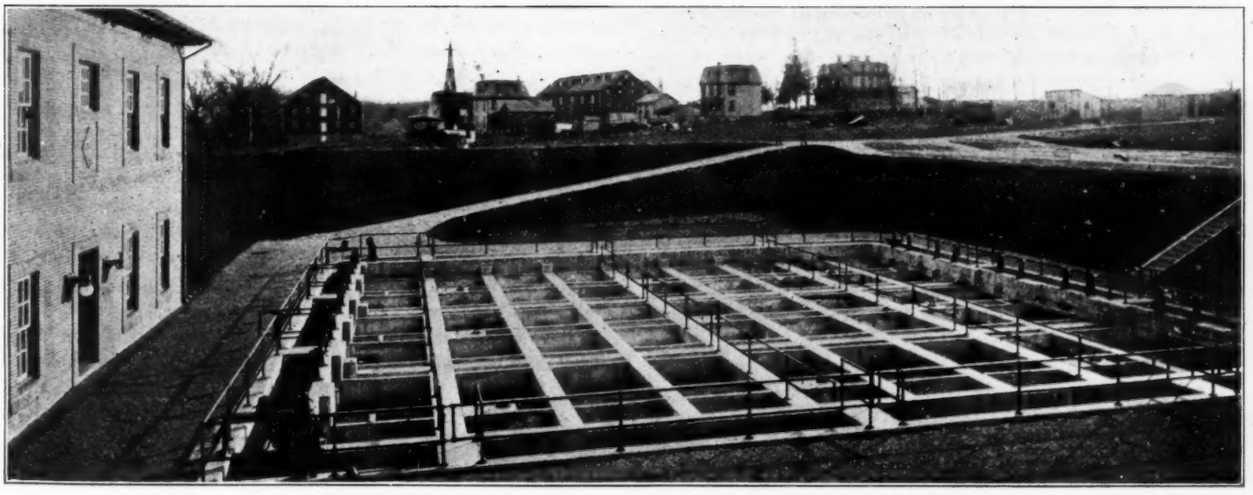
WATER PURIFICATION AND SEWAGE TREATMENT

Making Sure of Proper Operating Methods at York, Pa., Sewage Treatment Plant

The neglect of sewage treatment plants is an old as well as a sad story. Next to downright neglect comes faulty operating methods. If a plant has any care at all it can be made to work better if the operator is properly instructed by the designer. The present article goes into detail to show how a very full set of instructions was prepared to govern the operation of the sewage treatment plant at York, Pa. In these instructions the details are listed with more than usual fullness. The reader should not infer from our introductory remarks that the York plant was ever either neglected or poorly operated. It is a notorious fact, however, that most sewage treatment plants are either neglected or poorly operated, and this article is intended to emphasize the extreme desirability of having competent and well instructed sewage works operators in charge of treatment plants. Of course, this is a big plant and the instructions are extensive. However, even a simple set of instructions will prove invaluable to the average operator of a small plant and will insure better operation than where the designer forgets the plant and lets the operator struggle along unaided.

Brief Description of Plant

The York sewage disposal works consist of a coarse screen, 3 settling tanks of the Imhoff type, 4 sludge drying beds, a pumping station having a total capacity of 25,000,000 gals. per day and apparatus for automatically measuring the flow of sewage and disinfecting the tank effluent by the application of liquid chlorine. The works were designed to serve a population of 30,000, with an average dry weather flow of 4,500,000



VIEW OF SEWAGE DISPOSAL PLANT AT YORK, PA.

gal. per 24 hours, and double this amount for short periods during times of storm.

Screen Chamber and Venturi Meter

Sewage enters the screen chamber through a 60-in. sewer and passes through inclined bar screens with openings 2½ in. between the bars. The large matters in the sewage, consisting chiefly of rags, are caught on this screen, while the liquid and smaller matters pass on to the settling tanks. The screen is cleaned by rakes once a week and the accumulation taken from the screen, usually about a bucket full, is buried.

After passing through the screen, the sewage goes through a Venturi meter to the settling tanks. As the sewage passes through the Venturi meter the difference in head actuates an automatic recording device in the pumping station. This automatic recorder indicates the rate of flow in million gallons per 24 hours, gives a record to the total amount which has passed through the meter and also gives a chart of each day's flow.

A circular concrete sewer parallels the Venturi meter and conveys sewage from the screen chamber to the settling tanks during times when the Venturi meter may be temporarily out of service for cleaning or repairs.

The flow of sewage from the screen chamber to either the meter or the bypass is controlled by sluice gates in the screen chamber.

Settling Tanks

After passing through the Venturi meter, the sewage enters the channels around the tanks. The three settling tanks are built together with an outside channel extending around the four sides of the tanks. The three tanks and outside channel cover an area of 83 ft. square. Each settling tank is 72 ft. long by 23 ft. wide with a total depth of 27½ ft. Each tank is divided into two settling compartments each 8 ft. wide and 14 ft. deep extending the full length of the tanks. The sides and bottom of these settling compartments are made of hanging baffles of cement plaster on metal lath 2 in. thick. These baffles overlap at the bottom so as to form a slot 9 in. wide extending the length of the tanks. The overlap forms a gas trap so that no gases can pass upward into the settling compartments.

Below the settling compartments are the sludge digestion chambers. There are 3 sludge chambers in each tank. These chambers are 23 ft. square with sloping, hopper-shaped bottoms and have a depth below the settling compartments of 11 ft. Openings between the tank walls and the sides of the settling compartments lead directly to the sludge chambers, and provide for the release of gases generated by the decomposing sludge. The sewage upon entering the channels around the tanks is deflected in either direction by means of sliding gates. The flow from the channels into the tanks is controlled by means of swinging gates which deflect the flow into any tank. The sewage passes through the settling compartments, where, due to decreased velocity, the suspended matters in the sewage settle to the sloping bottoms of the settling compartments and slide through the slot into the sludge digestion chambers.

The liquid passes out of the tanks into the channel at the opposite end of the tanks and then through the lower part of the pumping station and to the Codorus creek. The flow of sewage through the tanks is reversed about every two weeks.

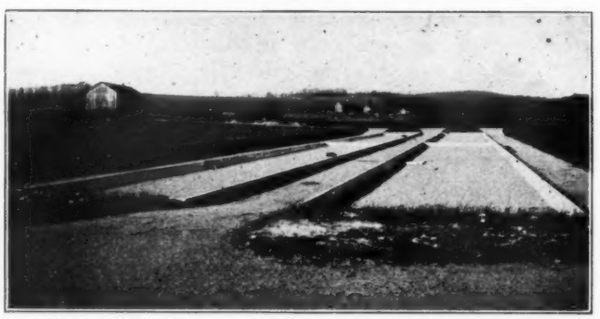
Sludge is deposited in greater quantities near the inlet ends of the tanks and by regularly reversing the direction of flow, the depth of deposited sludge is kept constant in the different sludge chambers.

The detention period of the sewage passing through the tanks is about two hours, so that the liquid leaves the tanks practically as fresh as when it enters them, but has in the meantime been freed of the floating and suspended matter it contained. The sewage on leaving the tanks is slightly turbid.

The sludge which has settled to the lower compartments is allowed to remain there approximately six months, during which time it has been decomposed from unstable organic matter into a staple form. This decomposition of the sludge is brought about by certain bacteria which grow rapidly under such conditions and is attended by a rather violent ebullition of gas. The gases, however, are inodorous, being largely carbon dioxide and methane. They escape through the gas slots at the sides of the tanks. After being decomposed, small quantities of sludge are withdrawn from the tanks and forced by compressed air onto the sludge drying beds. When put on the beds the sludge has a slight odor of tar. It quickly dries to an inodorous mass resembling garden soil. Sludge is withdrawn from the tanks without any interruption of flow.

Disinfection

After leaving the tanks the liquid portion of the sewage passes into the lower part of the pumping station, where it is disinfected by the application of liquid chlorine.



SLUDGE BEDS, YORK, PA., SEWAGE DISPOSAL PLANT.

This chlorine, which is a gas, is received at the works in steel cylinders of about 100 lbs. capacity each. These cylinders are attached to the chlorine apparatus where the amount of chlorine applied to the sewage is controlled. After being set to apply a certain amount of chlorine per million gallons of sewage, the apparatus automatically feeds the gas at this rate. After passing the control valve the chlorine gas is mixed with water and this saturated solution is fed into the effluent as it enters the pumping station.

A detention period of about 15 to 20 minutes is provided in the wells of the pumping station, during which time the chlorine thoroughly mingles with the effluent.

At the present time between 80 per cent. and 90 per cent. of all bacteria are being destroyed.

Pumping Station

During times of low water in the creek the sewage passes through the pumping station and into the creek by gravity. During times of high water in the creek the sewage must be lifted and forced out against the back water from the creek.

The pumping station building is two stories high with the suction and discharge wells below the lower floor. It is 60 ft. long, 30 ft. wide and built of brick and concrete.

The main pumping units consist of 3 motor-driven centrifugal pumps, each capable of pumping 5,000,000 gal. per day. There is also a reserve pump capable of pumping 10,000,000 gal. per day. This reserve pump is operated by a 50 H. P. gasoline engine and is an emergency pump in case that electric power is not available at the station.

The pumps are all on the top floor of the pumping station so that the lift is all suction lift of about 23 ft. maximum. The pumps are primed by a vacuum system which exhausts the air from the pumps and pulls the water up into and above the pumps. With the exception of the gasoline driven units, the pumping machinery is almost wholly automatic in its action.

The vacuum pumps are so arranged that they will automatically maintain the required vacuum. If the vacuum fails

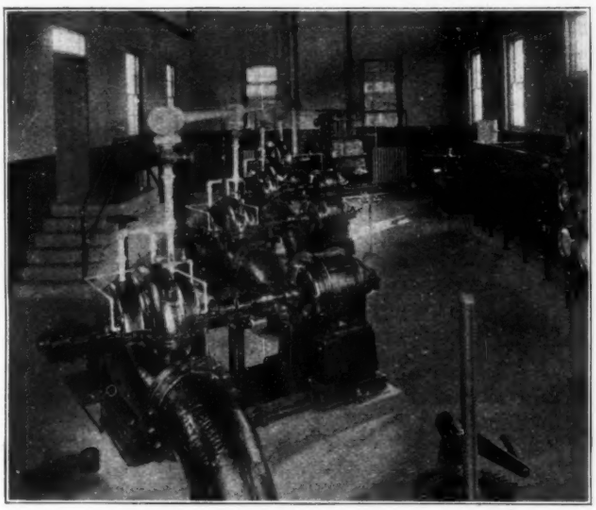
the pump automatically starts, stopping when the upper limit is reached. The same thing is true of the air compressor which supplies air for operating the sludge ejector and for starting the large gasoline engine.

The sewage pumps are controlled by float switches in the wells of the station. When the sewage reaches a certain level, one pump automatically starts. If the sewage flow is greater than the capacity of one pump and the sewage level continues to rise, a second pump is automatically started, and so on to the third. The pumps automatically stop in rotation as the level of the sewage falls.

On the lower floor of the pumping station is the office, the flow recording apparatus, the chlorine apparatus, the heating plant and toilet and washrooms.

Gauges on the upper floors give continuous charts of the height of sewage in the wells of the pumping station and of the water level in the creek.

Situated in a pit in the south end of the pumping station is the sludge ejector which lifts the decomposed sludge from the settling tanks and discharges it on the sludge drying beds.



GENERAL VIEW OF PUMPING MACHINERY, YORK, PA., SEWAGE DISPOSAL PLANT.

This ejector is operated by compressed air, and by setting the valves on the sludge, it is possible to pump sludge onto the drying beds or from one settling tank to another. The works are protected from high water by an earth dyke which is high enough to protect the works from floods such as that of 1884.

Samples and Tests

Samples of the sewage to show the amount of solids removed by the tanks are taken daily. These tests have shown a removal of from 90 per cent. to 100 per cent. of all matter capable of being settled out. Two sets of samples of sewage as it enters and leaves the settling tanks, of the sewage after being disinfected and creek water both above and below the outlet from the works are taken three times a week on alternate days.

One set of samples is kept at the plant and tested for putrescibility or putrefying action. These tests have invariably shown that the effluent of the works is more stable than the water in the creek. The other set is brought to the city laboratory at the city hall and the number of bacteria present is counted.

Complete records of all tests as well as of the sewage flow, height of water, amount of chlorine used, depth of sludge in the tanks and of all other operations of the plant are kept. Copies of these records are filed in the office and sent to the State Department of Health.

The plant has now been in continuous and successful operation for over a year, and no odors or objectionable features have ever been present.

Directions for Operating the York Sewage Treatment Works

Screen Chamber—Clean screens once a week. Record date of cleaning, amount of screenings, how disposed. Bury or burn screenings as soon as removed. Flush bottom of screen chamber as needed. There will probably be some heavy matter which will not be caught on the screen, but which may lodge back of the screen, and this should be flushed out before it has started to decompose. It is hard to tell just how often this flushing will be necessary, but a careful watch kept for these conditions will enable the operator to know when to flush.

Venturi Meter—Flush pressure chamber of meter and pressure pipes to pumping station twice a week. Close valves on lines leading to chlorine diaphram when flushing pressure pipes from pumping station. While flushing once a week has been sufficient up to the present time, to be on the safe side it is considered better to flush twice a week. If the valves on the lines leading from the meter pressure pipes to the chlorine controller are not closed when water is turned into the pressure pipes the chlorine diaphram will receive the full water pressure and is liable to be broken.

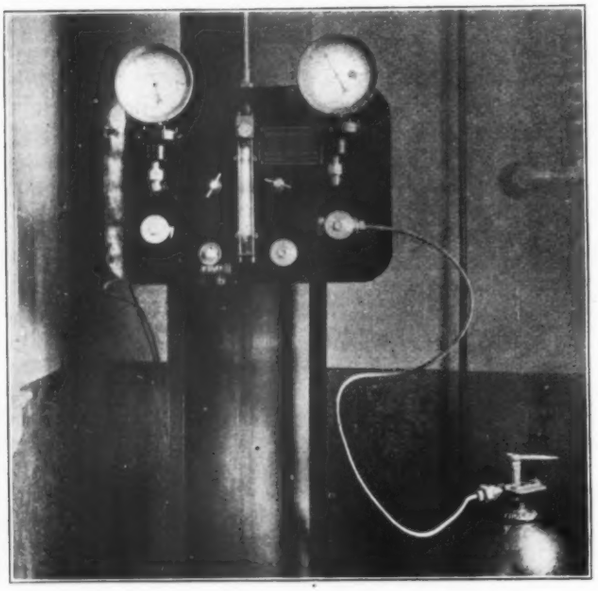
Venturi Meter By-Pass—Use only when necessary to clean body of meter tube. The by-pass should only be used when it becomes necessary to close off the Venturi meter for cleaning or repairs. After the by-pass is used, the gate in the screen chamber should be closed and a stream of water introduced at the manhole back of the gate in the screen chamber, and the by-pass flushed clean before the stop planks at the entrance to the tanks are put in place.

Channels Around Tanks—Keep channels clean at all times. Flush out deposits once a day in winter and twice a day in summer. Clean channels thoroughly before reversing flow in tanks. Deposits are most likely to occur in the channels at the inlet to the tanks and between the last swinging gate and the stop planks. Care must be taken to see that these deposits are washed into the tanks and are not allowed to get into the outlet channel and into the pumping station. Before reversing the flow through the tanks, be sure that the channel which is to become the outlet channel when flow is reversed is thoroughly cleaned and that the deposits are swept into the tanks. If this is not done the deposits in the channel will be washed into the pumping station when the flow is reversed. Deposits in channels and in pumping station tend to cause odors.

Settling Compartments in Tanks—Skim off oil, grease and floating matters once a day. Dispose of oil outside the tanks. Do not let oil from barrels get into the catch basins. Clean sides and bottoms of settling compartments once a week in winter and twice a week in summer. Clean slots once a week. Reverse flow in tanks once every two weeks. Remove all floating matter between scum boards and end of tanks before reversing flow. Break up ice which may form on tanks when about an inch thick or less. Keep sand or grit on hand for use on walks of tanks during cold weather. Reverse flow in tanks at time settling compartments are cleaned. In cleaning down the sides of the settling chambers the cleaner should be moved slowly and the deposits on the sides forced through the slot into the sludge chamber. This is especially necessary at the outlet end of the tanks so that the matters scraped from the walls are not stirred up and carried away into the outlet channel. See that every part of the tank is cleaned, for if deposits adhere to the sides and decompose, odors are sure to result. At times of reversing flow, clean down thoroughly all parts of the tanks between the scum boards and the end of the tank at the inlet end (or what will be the outlet end after flow is reversed). After the deposits which are stirred up in cleaning have settled, then reverse the flow. Most of the floating

matter on the tanks can be made to sink by sprinkling with water. Oil, however, must be skimmed off and removed from the tank.

Sludge Chambers—Measure and record depth of sludge once a week. Stir up sludge once a week with pressure water. Never let sludge get over 9 ft. deep as indicated by the tag on the measuring chain. Measure and record depth of sludge about 2 hours before and after removing sludge. Flush sludge pipes with pressure water after removing sludge. Remove sludge from tank No. 3 about May 1 and about every two months thereafter. About an hour before removing sludge, open valve B for a few minutes so as to loosen up the sludge around the sludge riser pipe. This should be done some time before sludge is drawn, so that the sludge has time to settle; otherwise partly digested sludge may be withdrawn to an objectionable extent. To remove the sludge, open the 8-in. valve at the sludge riser, the pressure of the water above will then force sludge into the pipes leading to the ejector in the pumping station. Sludge should be removed from one pocket of a tank at a time. The valve in the ejector pit must be set either to discharge sludge on to the drying beds or into another tank. If it is desired to discharge sludge into another



CHLORINE APPARATUS, YORK, PA., SEWAGE DISPOSAL PLANT.

tank, the 8-in. valve at the pocket into which sludge is to be discharged must also be opened. After a relatively small quantity of sludge is withdrawn the valve of that pocket is closed and sludge drawn from another pocket. After withdrawing sludge, the sludge pipes must be flushed. This can be done by opening valve C or by back-flushing from the air and water connections provided at the ejector manifold in the pumping station. In putting sludge into the sludge drying beds, do not use over about 50 lbs. of air pressure. In putting sludge into another tank instead of one of the sludge drying beds, do not use over 15 lbs. of air pressure and have the plugs at the top of the vertical sludge pipes secured in place. The water used in flushing should be discharged onto a section of the drying beds on which there is no sludge. The line leading to the beds may be back-flushed, if necessary, by putting water from a hose in the pipes at the beds. Watch must be kept at the sludge drying beds and if partly digested sludge appears, the valve leading to the bed must be closed at once. Partly digested sludge can be recognized by its grayish color, and by its foul odor. Digested sludge is brownish-black, with only a tarry or rubbery odor.

Gas Vents—Break up scum in gas vents daily. Record distance from top of scum to top of walls or "free board." Record appearance and odor of scum. If the floating sludge or scum which collects in the gas vents cannot be broken up by sprinkling with water, it will have to be broken up with a pole or otherwise. Large quantities of scum must not be allowed to collect in the gas vents.

Sludge Drying Beds—Put sand on beds before putting on sludge. Put sludge on beds preferably to a depth of about 6 to 8 in.; never over 12 in. Make the necessary measurements and records called for by operating sheets. Before applying sludge to the drying beds a thin layer (about ⅛ in.) of sand or very fine stone should be put on the beds. This will prevent the sludge from working down into the stone on the beds. When the dry sludge is removed from the beds much of the thin layer of sand will come off with the sludge so that the sand ought to be removed each time sludge is put on the beds. Never put partly digested sludge on the drying beds, but bury it at once. Do not put freshly withdrawn sludge on top of sludge already on the beds, as it will not dry quickly. Do not remove from the drying beds sludge which is only partly dried. Wet or freezing weather interferes with the drying of sludge so that it is better not to withdraw sludge during wet or freezing weather. Measurements should be made as soon as the sludge is placed on the beds and just before removal from the beds. Weather conditions during the time sludge remains on the drying beds should be carefully recorded.

Acknowledgement

The works here described were designed by George W. Fuller, Consulting Engineer, 170 Broadway, New York city. The instructions for operating the plant were prepared by George W. Fuller and J. K. Giesey, special assistant city engineer. We are indebted to Mr. Fuller for the views shown herewith.

State Highway Officials Favor Use of Motor Trucks to Relieve Rail Shortage

To consider auxiliary shipping measures of war products in the event of a possible car shortage, a meeting, called by R. C. Hargreaves, temporarily associated with a committee of the council of national defense, was held at the Detroit Board of Commerce recently.

Those present represented the state highways departments of the states of Indiana, Ohio, Michigan, Pennsylvania, New York, Virginia, as well as district engineers from the office of Director of Public Roads Logan F. Page, and the United States Army Engineer Corps, R. D. Chapin, chairman good roads committee, National Automobile Chamber of Commerce; William E. Metzger, chairman of the good roads committee, Detroit Board of Commerce; A. A. Templeton, president of the Board of Commerce; Captain Galbraith and William Inglis, with whom R. C. Hargreaves is associated in the present emergency war work.

A comprehensive plan of assembling supplies at important industrial centers was outlined, and the routes over which such products would travel by motor trucks destined for port terminals was discussed in detail. A typical object lesson of unpreparedness was cited in the Detroit-Toledo road, where a stretch nine and a quarter miles in length still remains impassable for heavy traffic.

What this particular stretch might mean in loss of Michigan blood in foreign fields was vividly described by Mr. Hargreaves. Great enthusiasm was aroused through a wire received from Governor Sleeper, pledging his support in the effort to immediately put this road in passable shape.

REFUSE COLLECTION AND DISPOSAL

Contract Plans and Specifications for Obtaining Refuse Incineration Works on the Most Economical Basis

By Rudolph Hering, D. Sc., Consulting Engineer, 170 Broadway, New York City

A satisfactory solution of the problem of City Refuse Disposal can result only when both sanitary and financial solutions are satisfactory and when the construction, management and operation of the works are sufficiently simple to be controlled with ease and reliability. We have had, and still have, some cases where both or either of the sanitary and financial solutions are not satisfactory, except under restrictions which are too complex for ordinary application, said Dr. Hering in an address to the American Public Health Association, here abstracted by him for MUNICIPAL ENGINEERING:

Interrelation of Plant Design and Operation and Refuse Collection

It is worth while to examine the efficiency and economy of sanitary refuse disposal works from this point of view. To do this, the inquiry should be made along three lines: First, the design and construction of the disposal works themselves; secondly, their operation, and, thirdly, the collection of the refuse in relation to its delivery at the points of disposal.

There is an intimate connection and interrelation between these parts of the subject. Any one of them may itself be satisfactory, yet at the same time one or both of the others may not. There have been cases where a cheaper cost of collection has required a more expensive disposal. There have been others where a cheaper disposal justified a more complex or more expensive operation or collection.

Assuming, which is true, that there are a number of ways in which the different parts of city refuse can be disposed of in an unobjectionable and a sanitary manner, it was customary for a long while to recommend the cheapest disposal, be it dumping, burial, incineration or reduction, wholly irrespective of the cost of collection and operation.

It was later found that the cheapest disposal works were not always the cheapest to operate. Some systems of incineration and of reduction, costing less for installation, were more expensive in operation. The unfortunate result of this practice has been that, to reduce the greater annual expense of operating a cheaper first-cost plant, its sanitary conditions were neglected.

It was also found that a greater annual cost of the disposal works could be more than balanced by a smaller cost of collecting and delivering the refuse to them.

The result of these facts shows that a city, in order to ascertain the most satisfactory sanitary solution of its refuse disposal problem, should not ignore the interrelation of the three above mentioned integral parts. It should find the least combined annual cost of all three of them, under conditions requiring all parts to give inoffensive results.

After stating this general conclusion regarding the city refuse problem, it is the author's object to consider in detail one kind of final disposal works, namely, incineration, and to call attention specifically to some feature of their contract plans and specifications that have recently enforced attention.

General Consideration Affecting Bids

It is important, in view of what has been said, that bids should be asked for in a way to get the most efficient and most economical system, beginning at the point of collection and ending at the points of final disposal, under the specific conditions existing in the city. It is essential, first, that a decision as to the general solution of its problem should be reached after sufficient preliminary engineering studies have been made; and, secondly, that specifications and general plans be prepared which will secure the most economical of perhaps several efficient projects.

In preparing specifications, a complex phase is sometimes introduced by providing not only for the incinerators with their machinery, but also for the buildings to house them. The first is the work of an engineer, the second that of an architect. Further, it is difficult to predict all the conditions that will obtain after the plant has been turned over for operation. It may be well to keep the details of utilizing the by-products, namely, steam and ashes, in abeyance until a practical demonstration has been made of the plant under the local working conditions. It may be questionable whether it is best to use the steam in connection with the water works, the sewage or other pumps, the manufacture of ice or other products, etc. As the refuse itself varies its fuel value also varies, and the quality of the ashes or clinker may differ materially.

Local preferences may vary as to the amount of money at the outset should be spent for the external appearance of the buildings and of their surroundings. It might be arranged to have the contractors bid for the furnaces and machinery alone, from which bids the city could select the type of furnace desired. Then an architect could plan the buildings and surroundings appropriately. Or, the contractors could include the price for the most simple building to house the machinery; or, they could state a certain percentage price at which they would furnish the material and labor for, and superintend the erection of, the buildings as they would be designed and specified by the city.

Let us now assume that the incineration of all, or of a part of the total refuse is required, that the site for an incinerator has been selected, its desired capacity fixed and that the general type and arrangement of the plant have been determined. The city should then prepare a general layout, suiting the property secured, and designate as much detail as it desires regarding the buildings, the furnaces and machinery, specify the quality of materials and construction, the arrangements demanded for operating the plant and the basis upon which bids will be received to secure the lowest continuous operating cost.

Getting Bids

After such a preparation, competitive bids can be obtained on a uniform and safe basis. Unless such definite conditions as these are stated, some bids might be based on inferior material and workmanship, as well as on undesirable types of furnaces and machinery, that would eventually produce unsatisfactory results, and, therefore, not offer fairly comparable bids, should other and higher bids have been based on better machinery, better material and more careful construction.

In order to facilitate a fair comparison of the bids the city should specify all essential requirements, based on the results of the engineer's study, as mentioned above, but including also the amount and kind of refuse, the time of its delivery, the size of chimney required, the floor spaces, the desired general handling of delivery wagons, the desired way of removing the ashes and other similar but essential details.

Unless bids are asked for in this manner, there may be added to the numerous instances already on record more such cases where the sanitary results are unsatisfactory and where the operating costs are unexpectedly high, due to inefficient handling of the refuse, difficulties in removing clinker, congested furnace room, chimneys of insufficient draught and for other reasons.

Plans

The city plans should show the site with the elevation of the ground, the borings made to firm foundations and the streets and railroads adjoining or near the site. It should also indicate the approximate location, size and shape of the furnace building, and of its accessories, so far as the city wishes to indicate them.

The bidder should submit plans of the furnaces, their appurtenances and the entire equipment of the plant asked for, so that the city may have the advantage of a lower price for using stock patterns. These plans should be prepared in sufficient detail, so that an expert engineer for the city can fully comprehend every essential part, as related to the design and construction of the building, the approaches, the arrangement, design, construction and operation of the furnaces and of the main accessories and appurtenances, so far as the city has left the choice to the bidder.

Specifications

The city should specify all matters that are necessary to protect its interests in the general design and construction of the plant and to present all required conditions as to labor and materials as fully and as clearly as possible, so that the bidders are not left in ignorance on any essential matter that is required and can make a fair bid on a uniform basis with other bidders. In order to get a low bid from the best contractors, the city should assume all chances over which the contractor can have no control.

All terms should be clearly defined to avoid misunderstandings. Whatever the city will furnish to, or demand of, the contractor, in the way of supervision, inspection, labor and material, must also be clearly stated. The composition of the garbage as to combustible, ashes and water should be given within reasonable and safe limits. If the city has decided upon any details in the arrangement of the plant and handling of the refuse material, the ventilation of the building or any arrangement for preheating, draught air, for forced draught, steam generation, etc., these should all be clearly stated.

On the other hand, the bidder should submit specifications describing in full detail the construction of the furnaces and their appurtenances and the entire equipment proposed by him within the city's specifications, so that the efficiency and durability of the plant can be fully comprehended by the city's expert engineer.

The bidder should specify the power required to operate his proposed furnaces at their maximum capacity, the man-hours of the different kinds of labor required per ton of refuse to be incinerated and the average rate of evaporation in the proposed boilers, from and at 212 degrees Fahrenheit, per pound of refuse consumed and having a composition specified by the city. He should also furnish evidence of previous and similar work he has done.

This information should be sufficient to determine during a test to be prescribed by the city, not only the efficiency of the plant, but also the annual cost of incineration per ton of refuse.

Guarantees

It is proper when a competent expert contractor submits his own plans and specifications and bases a bid thereon that he should be willing to guarantee certain results. Some of the guarantees that would be required on the part of the city cannot always be stated with such definiteness that they are entirely independent of judgment. The city engineer, or some special expert in this matter, is, therefore, usually given the power to use his judgment in the interpretation of such guarantees. Some specifications have statements in a form, either too definite or not definite enough, with the expectation that, as the courts have frequently ruled, a reasonable interpretation could and would be made.

A few recent court cases have shown that judgments have varied substantially. It is, therefore, necessary that the specifications assist our judgment as much as possible, by stating in such cases, rather an approximation, than an absolutely definite result, which approximation is within the limits of practical experience in the art.

Specific Guarantees

It may be well to refer specifically to some of the guarantees heretofore given for a refuse incinerator:

Nuisance

1. No nuisance shall be created in the normal operation of the plant.

It is hard to define the word "nuisance" outside of personal judgment. Therefore, it is better to specify an odor, offensive to the average person, and a disorderly scattering of garbage and rubbish outside of the intended areas or receptacles, which is offensive to the average eye, should be considered a nuisance.

The term "normal operation" has been liable to confusion. This normal operation may refer to a test period which may be one day or thirty days, or it may refer to a whole season. A short test is best to ascertain efficiency and freedom from some kinds of offense, and a long test to ascertain endurance and freedom from other kinds of offense.

Temperature During Test

2. During the prescribed test the temperatures in the combustion chambers should not fall below 1,250 degrees Fahrenheit more than three minutes in any one hour, and that a continuous record shall show an average temperature of at least 1,400 degrees Fahrenheit.

This is an improved specification over an earlier one, that at no time during a test the temperature should fall below the above minimum. Yet it should be evident to a practical engineer that a drop of temperature for even four or five minutes in one hour would be due to a matter of temporary operation, possibly to new and not sufficiently experienced men, and not due to the design or construction of the plant.

Odors, etc., From Chimney

3. No odors, obnoxious gases, smoke or dust shall be emitted from the top of the chimney.

This specification, when strictly interpreted, is too definite as regards the top of the chimney, smoke and dust, and it is too indefinite as regards odors and obnoxious gases. A reasonable interpretation as well as the evident intention should be that it matters not what escaped at the top of the chimney; it is important that no solid or gaseous materials descending to inhabited buildings or upon the ground of the neighborhood should be objectionable. As it is impossible to have no dust whatever, nor any fine particles of smoke escape from the chimney, it has been proposed to substitute a specification that no dust particles shall escape from the chimney that cannot be settled at a velocity of 5 ft. per second. This would insure the settling of whatever dust would be objectionable before it reaches the top of the chimney. Whatever dust particles would then escape are incinerated organic and mineral matter, and would certainly not be any more objectionable than the ordinary dust raised from the surface of any average street by an ordinary breeze.

Furnace Residue

4. The residue from the furnace shall be thoroughly burned and free from organic matter.

It has accordingly been interpreted that no organic matter,

not even carbon particles, should be contained in the ashes. This would clearly be an unreasonable and unintended view. The first object of this particular specification should be to secure a furnace which, under proper operation, will turn out a residue incapable of causing a nuisance, *i.e.*, a subsequent offense at any time. This result could be obtained if the residue were nothing but carbon, and also if but a small percentage of the residue, such as one or perhaps 2 per cent., is unburned organic matter. Due to the practical operation of charging, stoking and of drawing out the ashes it is impracticable to avoid some incompletely burned matter occasionally from passing down into the ash pit. As such an insignificant amount has never been considered objectionable in modern plants, even when the ash is used for making artificial stone, no efforts have been made to further reduce it, and should not be objected to by the courts.

To avoid an unreasonable interpretation in such a case it is better to place a limit to the amount of incompletely burned organic matter which may be contained in the ashes of an incinerator. But even such a limit might be open to misinterpretation, unless the condition of the organic matter is also stated. If it is "resistant" organic matter, like wood, straw, bone, hair, feathers, etc., a very large percentage, even in an unburned condition, would not produce any objectionable results. But if the matter were "non-resistant," like flesh, or some vegetable pulp, perhaps partly putrified, a very small percentage might be offensive near by. Fortunately, in any refuse incinerator, that here deserves consideration, the non-resistant organic matter, when contained in mixed refuse, generally soon disappears by losing its moisture through absorption and evaporation. A dead mouse covered an inch or two with powered charcoal or fine ashes dessicates and spreads no odors.

Other Usual Guarantees

There are other usual guarantees which can be and have been quite definitely stated. Such are a statement of the least number of man-hours of labor per ton of refuse incinerated, computed according to a definite schedule, the least evaporation in the boilers under given conditions and a statement that the various parts of the incinerators must be so arranged that any one unit may be shut down to remove ashes and dust or to make minor repairs without disturbing the incineration process in any other unit.

Tests

In order to ascertain whether a plant is capable or not of fulfilling the requirements of a contract it is necessary to make a suitable test. For this purpose the city must provide sufficient refuse of the composition stated in the request for bids, and upon which the bid was originally based. The contractor must put the furnaces and their appurtenances into a working condition before the tests are begun and the city must designate a fixed period and time for the test.

It is important also to ascertain the amount of combustible and of free water contained in the refuse just before the material is dumped into the furnaces, and the specifications should fix the approximate limits between which the amounts may vary.

The city and contractor should jointly select the men required for operating the plant during the test. This should be made under the full direction of the contractor and in the presence of a city representative. The preliminaries of the test being thus completed, the fulfillment of each and all of the guarantees is then ascertained.

Conclusions

When disagreements exist between a city and a contractor, and as the controversial questions depend usually upon special knowledge and experience, it seems better to select, if possible, a single intelligent arbitrator, having had direct and sufficient experience with the particular subject in question, than to select two or possibly three intelligent persons, one or two of whom may be obliged to resort partially to an opinion which may be based upon a short or no actual experience.

The lowest bid will be that which provides a furnace and appurtenances, the operation of which under guaranteed conditions requires the least total cost per annum. This cost would be made up: First, of the interest charges on the construction expenses, the annual depreciation and all other fixed charges; and, secondly, of the net cost of operating the works of a stated capacity test period, reduced to one year, and which would consist of the required labor, machinery, tools, power, light, heat, repairs and the maintenance of buildings, grounds and office. The lowest combined annual costs will indicate the lowest bid, and, therefore, the most economical plant for the city.

In closing it may be well to revert to what was intimated at the outset, concerning the dangerous economical mistake for a city to consider only one part instead of all three integral parts of the problem.

BRIDGES AND BUILDINGS

Pennsylvania Specifications for Culverts and Short-Span Concrete Bridges

The essential clauses of the Pennsylvania state highway department specifications for culverts and short-span concrete bridges, recently adopted, are here given.

Foundations

The excavations for foundations shall be according to the dimensions shown on the plans and shall be carried to such depth as is necessary to secure good foundations free from all danger of damage from frost or scour. If such depth is greater than that shown on the plan, the additional concrete that may be required, shall be paid for at the price bid per cubic yard for additional concrete in foundations. Excavated material shall be deposited between the wingwalls or as the supervisors may direct.

The direction or length of wingwalls may be altered by the supervisors to suit special conditions at the site, and additional concrete that may be required, shall be paid for at the price bid for additional concrete required in the wingwalls.

If suitable foundation is found at less depth than that shown on the plan, or if the yardage of concrete is decreased by alteration of the wingwalls or by any other cause, the amount of such reduction, at the price bid per cubic yard, shall be deducted from the lump sum price.

Piling

Where satisfactory foundations cannot be obtained 4 ft. below the bed of the stream, piling may be used, and, unless otherwise shown on the plans, the spacing shall be 3 ft. center to center, and the piles shall be designed to take the full load. For safe loading, the following shall be used: Safe load in lbs. equals 2WH divided by S plus 1, where W equals weight

of hammer, H equals fall in ft. and S equals penetration in inches under last blow of hammer, but the maximum load on any single pile shall not exceed 20 tons.

After driving, the top of piles shall be trimmed of all broomed wood. The minimum projection into the concrete shall be 18 in. and the maximum 36 in. Before concreting, all earth loosened by driving shall be removed from around the piles.

All foundations shall be inspected by the supervisors before any concrete is placed in them.

Stone Masonry

Should it be desired to use stone masonry laid in cement mortar in the foundations, abutments and wingwalls, instead of concrete, the thickness of all such parts shall be made 10 per cent greater than those shown on plan.

Stone for masonry shall be clean, sound and durable. No stone shall be less than 6 in. in thickness unless otherwise permitted by the supervisors. No stone shall measure less than 12 in. in its least horizontal dimension, or less in a horizontal direction than its thickness. All mortar used shall be composed of one part Portland cement and three parts sand, and shall be mixed in such quantities as will insure its immediate use.

Stones shall be roughly squared on joints, beds and faces, and be laid on their natural beds so as to break joints and in full mortar beds. At least one-fifth of the stone in the face shall be headers, evenly distributed throughout the wall. All vertical spaces shall be flushed with mortar and then packed with spalls. No spalls will be allowed in the beds. Selected stone shall be used at all angles and shall be neatly pitched to true lines and laid on hammer dressed beds; draft lines may be required at the more prominent angles. Tops of wingwalls and parapets shall be capped with concrete not less than 6 ins. thick which shall project 1½ ins. over face of wall.

Forms

False work for slabs reinforced with bars or rails shall be unyielding and constructed with 1 in. of camber for every 10 ft. of span. For bridges constructed of I-beam stringers, the false work shall be supported from the beams.

All forms must fit tightly together to prevent leakage and be so braced that there will be no sagging or bulging under the weight of the concrete. Forms of all exposed surfaces shall be made of smooth lumber, surfaced to uniform thickness and be coated with oil or soap to prevent the concrete from adhering to them.

Forms on vertical surfaces that will be exposed to view in the finished work shall be removed in not less than 12 hours and not more than 48 hours, and the surface rubbed with clean water and a wooden float or carborundum block until it assumes a uniform sandy appearance. No painting or cement washing will be allowed.

Concrete

All concrete shall be most thoroughly mixed. If hand mixed, the sand and cement shall first be mixed dry, then water shall be added to make mortar, then the stone which has been previously wet shall be added and mixing shall continue until all particles of stone are completely covered with mortar. Concrete shall be placed in the forms immediately after mixing.

Concrete for the abutments and wingwalls shall contain sufficient water to cause it to flatten out and quake, but not to flow.

Concrete in which steel is embedded shall contain sufficient water to cause it to flow sluggishly.

Class "B" concrete, composed of 1 part by volume of Portland cement, 2½ parts of sand and 5 parts broken stone or gravel, shall be used for foundations, wingwalls and for abutments up to clearance line of bridge.

Class "A" concrete, composed of 1 part by volume of Portland cement, 2 parts of sand and 4 parts of broken stone or gravel, shall be used for floor slabs, beam casings and parapets.

Cement shall be true Portland cement of well-known brand, which shall be subject to the approval of the supervisors, and shall conform to the standard specifications of the American Society for Testing Materials, dated January, 1909. It shall be free from lumps, caking or watermarks, and when delivered on the work shall be in undamaged packages. It shall be stored on the work in such a manner as to be perfectly protected from wet or moisture.

All cement shall be subject to inspection and test, and cement not complying with the requirements will be rejected.

Water used in concrete shall be fresh and clean, and free from sewage or acids.

Concrete Materials

Sand shall be clean and hard grained, and shall be graded from fine to coarse, with no particles larger than ¼ in. in size. It shall be free from loam, silt or other foreign matter.

Gravel shall be composed of clean, hard particles, and be free from dirt or foreign matter of any description.

Stone shall be hard and durable, broken into approximately cubical particles, and be free from dirt or foreign matter of any description.

For Class "A" concrete: Gravel or broken stone shall be uniformly graded in size from ¼ to ¾ in.

For Class "B" concrete: Gravel or broken stone shall be uniformly graded in size from ¼ to ½ in.

No concrete shall be laid in freezing weather without the permission of the supervisors. For placing concrete in freezing weather the contractor shall establish a suitable plant for heating the water, sand and crushed rock or gravel. After placing the concrete the work must be thoroughly protected. Final approval of concrete masonry, laid in freezing weather, will not be given until inspected after continuous warm weather for at least 30 days.

Structural shapes shall be medium steel, manufactured by the open hearth process, and shall conform to the specifications of the American Railway Engineering Association, dated 1910.

Reinforcing

Reinforcing steel shall be medium steel, manufactured by the open hearth process, and shall meet the requirements of the specifications adopted by the Association of American Steel Manufacturers for concrete reinforcing bars.

Reinforcing shall conform in size, form and position to the drawings, and shall be securely held in place during concreting. It shall be free from rust, dirt, grease and thick or loose mill scale.

Pipe railing shall be straight and true to the dimensions shown on the plans, and be erected in a most workmanlike manner.

Posts shall screw into fittings. Rails shall screw into end fittings and slide through intermediate fittings. The pipes shall be galvanized and all spots where galvanizing has been damaged shall be painted with aluminum paint.

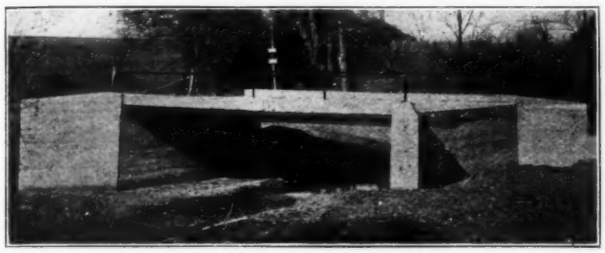
Forms of concrete parapets or railing shall be constructed of desired lumber, and be erected with extreme care, and securely braced in place in order to insure the finished work being straight and true. Concrete shall be carefully spaded while being deposited. Special care shall be used in removing forms to avoid damaging the corners of the work. After removal of forms (in approximately 12 hours), the parapet shall be rubbed with a wooden float until it assumes a uniform sandy appearance, and all lines and panels are true and pleasing to the eye.

Design and Construction of Road Culverts and Bridges in Pettis County, Mo.

By T. O. Stanley, Highway Engineer, Pettis County, Sedalia, Mo.

During the last four years Pettis county, Missouri, has built more than 1,000 road culverts and nearly 100 bridges.

We build all our small culverts from 2 to 4 ft., of the box type. Over that, up to 10 ft., we build the arch type, if the



ELM BRANCH BRIDGE, PETTIS CO., MO.; SPAN, 30 FT.; ROADWAY, 18 FT.; COST, $569.

opening will permit; if not, we build the box and use additional reinforcement.

For reinforcing the small culverts on the top we use either an expanded metal, or woven wire, reinforcement. On the larger box culverts, in addition to woven wire, we use reinforcing bars sufficient to carry a live load equal to a 12-ton road roller. All culverts have a clear roadway of not less than 20 feet.

In bridges with 10 to 30 ft. clear spans we reinforce with steel I-beams. We arch between the beams, and spread one layer of woven wire on the top of the beams and build the concrete 2½ to 3 in. above the top of the beams. All bridges having a clear roadway of not less than 16 nor more than 20 ft., and built to carry a load equal to a 12-ton road roller the same as the culverts.

For bridges longer than 30 ft. we buy the fabricated steel and erect the bridges with concrete floors in about the same manner as in the smaller ones.

In all our work we buy the material, hire a reliable fore-

PEPPER BRIDGE, PETTIS CO., MO.; SPAN, 40 FT.; COST, $919.

man and erect the bridges by force account and eliminate the contractor's profits, as we think we can do it as well as he can, and at least save the overhead expenses.

As to the cost, that depends a great deal upon the distance the material has to be hauled, but our small culverts for the last three years have cost us approximately $50 each, while our larger ones have cost less than $100 each.

Our bridges of 10 ft. or more clear span have been costing us from $10 to $15 per lineal foot, including the foundation, and in some few instances, where the foundation was bad, they have cost as much as $20 per foot or a little more.

FROM WORKERS IN FIELD AND OFFICE

Experience With Frozen Water Meters in Terre Haute, Ind.

The Editor of MUNICIPAL ENGINEERING:

Sir—

Last winter was unusually cold with us, and the coldest weather came at a time when there was practically no snow on the ground. Our soil here is composed largely of sand and gravel, altho there is clay in a small portion of the city.

We have had meters set in outside boxes for many years, also in brick pits about 2 ft. 8 in. in diameter at the bottom and about 3 ft. deep, the meters being set on risers coming up from a depth of, say, 4 ft. 6 in. to 5 ft. We also have brick pits that are about the same diameter, but 4 ft. 6 in. to 5 ft. in depth, the meters being set at the bottom. Previous to last winter it is probably safe to say that we had never had a meter frozen in a brick pit either 3 ft. in depth or 5 ft. in depth.

Last winter we had about 7,000 meters, and probably 80 per cent. of these were outside installations. During the spring and summer of 1916—that is, previous to last winter—we set some 3,700 meters, most of them being installed in 15-in. tile, 3 ft. 6 in. long, on which was a cast-iron meter box cover 9 in. in depth, with a double lid or cover. As our time for installing most of these meters was very limited, some of them were not set in the center of the tile, and the result was that the risers were either touching the tile or very close to it.

Out of 7,000 meters in service, there were about 2 per cent. that were frozen. Among these were meters in 15-in. tile, in 18-in. tile, in the brick pits, and also in basements. In other words, the trouble was not confined to the meters that were set in 1916 nor to the meters in the 15-in. tile. We made an investigation to determine just where the meters were frozen, and from the information gathered we were not in position to point to any one particular style of setting where the proportion of meters frozen was greater than in the others; while there were more meters frozen in the 15-in. tile than in the brick pits and 18-in. tile, yet the proportion of the entire number of installations was not large. The most remarkable thing about it all was that meters were frozen in the brick pits, where they had never frozen before, altho we have had winters where the temperature was as low as it was last winter.

We have planned to give the places where the meters were frozen greater protection than they have had in the past, by installing in the 15-in. tile a cone-shaped tube that will extend from the yoke where the meter is set up to the inside lid of the box. The lower portion of the tube is the same diameter as the tile. These cones are made of three-ply roofing material and are substantial in character and construction. The object is to confine the warm air around the meter and prevent it coming in contact with the frozen ground which surrounds the upper portion of the tile.

It seems, from what I have been able to gather from the experience of others in this section of the country, that the atmospheric conditions last winter were unusual. This is

based on the information to the effect that there were more meters frozen in the various cities in this section during last winter than during any previous winter.

Yours very truly,

DOW R. GWINN,

President and Manager, the Terre Haute Water Works Co.

October 6, 1917.

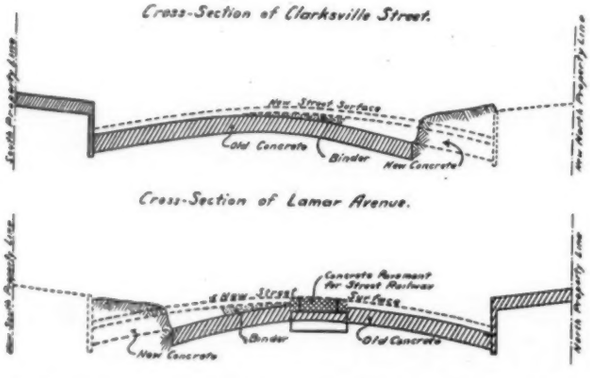
Using Old Concrete Base in New Pavement on Widened Streets

The Editor of MUNICIPAL ENGINEERING:

Sir—

After the big fire in Paris, Texas, in the spring of 1916 the decision to widen the streets was reached. This required a change in crown and the removal of the old curbs and sidewalks.

A plan was devised by Hans Helland, Jr., then city engineer and now a captain in the engineering corps, United States army, to use the old concrete base where practicable. The new base was built over and on the old one which was first thoroughly cleaned. The new base was in no case less than



SECTIONS SHOWING USE OF OLD PAVEMENT BASE IN STREET WIDENING, PARIS, TEX.

3 in. thick. Where a less thickness than this was required to bring the old base up to the new grade, a binder was used of the sort commonly employed in asphalt pavement construction. The accompanying line cut shows the detail of the design.

Where the new grade cut the old base the entire base was removed and a new base of proper thickness built to the new grade. The street car track was not moved and is 3 ft. off center.

In widening our streets this scheme was used very satisfactorily and at a very small cost. The old topping was removed, the new concrete was placed so as to shift the crown, binder was used to keep from running concrete to feather edge. Then we placed the regular 2-in. bitulithic topping.

Yours very truly,

W. W. WHIPKEY,

Paris, Texas. City Engineer.

Method and Cost of Melting Snow With Asphalt Road Heater

The Editor of MUNICIPAL ENGINEERING:

Sir—

The accompanying illustration shows the novel use of an asphalt road heater for melting snow in Glencoe, Ill. The heater was used by John A. McGarry & Co., of Chicago, Ill. It is an 8-ton Iroquois roller converted to the use described by the Barber Asphalt Company. The large flue was built on to carry the flue gases over the top and down to the 5 x 7 ft. hood.

A 4-inch snowfall covered up the last 5,400 sq. yds. of a 63,000 sq. yd. penetration job and the heater was used to melt

MELTING SNOW FROM UNFINISHED PAVEMENT WITH ASPHALT ROAD HEATER.

the snow from the 2 in. of top stone already spread on the concrete base. The cost of the snow removal was as follows:

Removal of heavy part of snow by hand	$17.00
Rent of heater, 4 days at $20 a day	80.00
Engineer at $6.25 per day, including carfare	26.00
Helper at $3.50 per day, including carfare	14.00
Pocahontas coal at $6.25 a ton, delivered, at ½ ton per day	12.50
Total cost	$149.50

This amounts to nearly 3 cts. per yard for melting alone. The actual pouring was also retarded about 50 per cent., as it had to be done close behind the heater, and the stone screening for the top also had to be heated. The writer is indebted to J. T. Child for the accompanying photographs and data.

Very truly yours,

FRANK C. PERKINS.

Buffalo, N. Y.

A Glimpse of Wooden Ship Construction

The Editor of MUNICIPAL ENGINEERING:

Sir—

The accompanying view illustrates one of the famous Western Wooden Shipyards. The writer and his company have been connected with hoist equipment for a good many years in the East and came West with the idea that all equip-

VIEW OF WOODEN SHIPS UNDER CONSTRUCTION, SHOWING ALL-WOOD DERRICKS.

ment should be of fabricated steel. We studied the Western situation where the timber is of such large proportions that it enables one to use it in the manufacture of machinery and equipment instead of steel construction.

After studying the situation over here in the West, we have come to the conclusion that a wooden constructed traveling stiff leg derrick, properly constructed, can be built much cheaper and give better service than the steel derrick.

The derricks shown in the accompanying photograph are

placed between each two ships along a gage track of approximately 23 ft. The booms are provided 83 ft. in length, swinging entirely clear of all the scaffolding and original construction of the wooden ship.

On a platform mounted approximately 15 ft. above the derrick is a machine which operates the boom and hoist. The operator's point of operation is on a lever at the bottom of the machine, approximately 30 ft. above ground, from which point a full view can be obtained by the operator. Therefore, a signal man is not required. This also enables the wooden shipyards to construct the steel parts for the bed of timbers underneath the derrick.

This derrick is capable of traveling at a speed of approximately two miles per hour and handling loads up to 10 tons.

The old method of constructing wooden ships was to leave an opening in the front end of ship to pull all heavy timbers thru the bow by means of a donkey engine. This, we learn from observation and what literature we are able to obtain, is the common method used at the present time in a good many wooden shipyards; but after having equipped a number of the largest western shipyards with handling gear as required, we have found that the handling cost is reduced more than 50 per cent.

The Burbank Machinery Company, 3223 First avenue, South, Seattle, Wash., are the originators and designers of the derricks here described.

Very truly yours,

F. R. SCHOEN,

Seattle, Wash., Oct. 3, 1917.

Old Sand-filled Brick Pavement Relaid Monolithically

The Editor of MUNICIPAL ENGINEERING:

Sir—

About a year ago the city of Champaign, Ill., in an attempt to solve the problem of settlement, sand flows and the like relaid two short stretches of sand-filled brick pavement, using the old brick and a fresh concrete bed in place of the old sand cushion. The results obtained were so satisfactory that in relaying a badly settled and very rough pavement in one of the subways this fall the same scheme was used.

The old brick were first removed and thoroughly cleaned with wire brushes. The sand cushion was then removed and the old concrete base swept clean. A layer of concrete consisting of 1 part cement, 3 parts sand and 2 parts roofing

RELAYING OLD SAND FILLED BRICK PAVEMENT MONOLITHICALLY, CHAMPAIGN, ILL.

gravel was then spread and struck off to correct shape and elevation. Owing to the unevenness of the old base this layer varied from 2 to 6 in. in thickness. The old brick were immediately relaid on the soft concrete and rolled with an 800-lb. hand roller. The joints were then filled with a 1:1 grout in the usual manner, and the street blocked to traffic for two weeks to permit the cement to harden. The old brick were repressed block of good quality and but very little worn, although about 12 years old, and therefore were easily laid, and but few replacements with new brick were required.

The work was done by the regular street repair gang, with the equipment available at a cost of about 75 to 80 cts. per square yard. It is thought that with proper equipment and organization that a contractor could do this work at less cost to the city and still secure a reasonable profit. Nevertheless, the finished work is smooth and sightly, and replaces a very unsatisfactory pavement with structure fully as good as an entirely new pavement at about one-fourth the cost.

The work, both on the experimental sections and the subway, was planned and carried out by F. C. Lohmann, city engineer.

Very truly yours,

C. C. WILEY,

Instructor in Highway Engineering, University of Illinois.

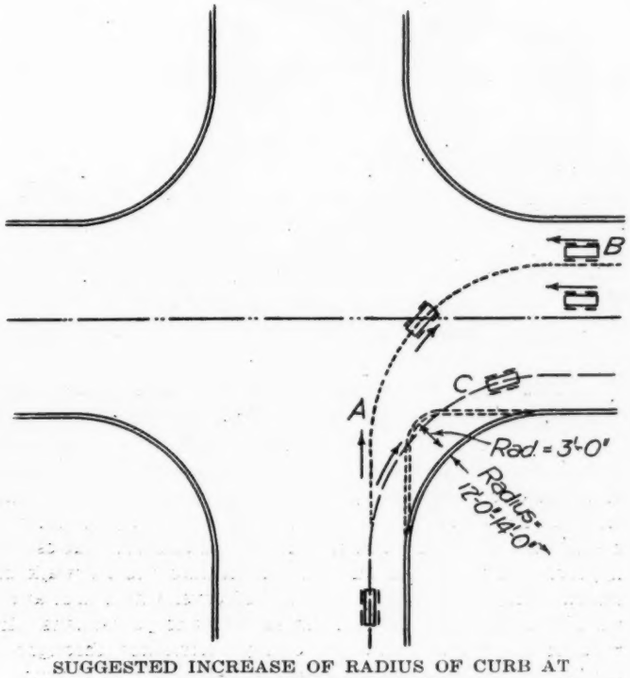
Urbana, Ill.

Lake Shore Drive (Chicago) Intersection Shows Advanced Practice in Curb Design

THE EDITOR OF MUNICIPAL ENGINEERING:

Sir—Street intersections are too commonly laid out with little thought of the change that has come about in vehicular traffic. Slightly rounded corners, once satisfactory, do not now make for convenience and safety and the practice is to be condemned. In the time of slow-moving, horse-drawn buggies and wagons of short wheel base they were satisfactory but they do not meet the needs of motor traffic.

The accompanying illustration shows the intersection of Lake Shore drive and Division street, Chicago, where the original 1½-ft. radius curb has been replaced by one of about 14-ft. radius. The old curb had not yet been removed. The distance



SUGGESTED INCREASE OF RADIUS OF CURB AT STREET INTERSECTIONS.

from the old corner to the new is 7 ft. on one corner and on the other 5 ft.

Vehicles turning into Division street had been forced to swing out into the center of the street or beyond, while the new curb permits a vehicle to make the turn with only slight speed reduction and without passing over the center line of the street. The diagram shows this clearly. Except at extremely low speed, a vehicle cannot avoid crossing the center of the

street in making the turn in the case of the old curb, while the long radius of the new curb permits it to keep to the right, in accordance with traffic rules.

Long radius curbs involve no construction difficulties. There can be no opposition to their adoption for all new work and a change of practice is imperatively needed where one or both of the intersecting streets have much swift-moving motor traffic. But the change should not be confined to new work. In every city there exist many dangerous intersections with boulevards or narrow streets where it would be in the interest of the city to reconstruct curbs in order to promote safety and to prevent delay and congestion.

Very truly yours,

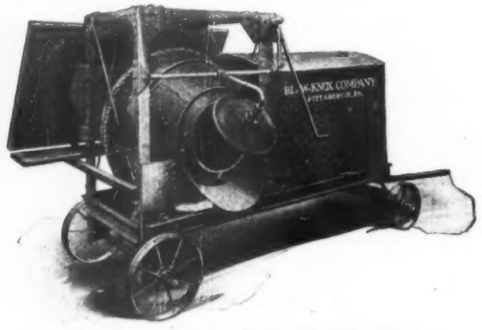
B. F. Affleck,
President Universal Portland Cement Co.

Chicago, September 8, 1917.

Plant Units and Lay Outs

A New 10-cubic-foot Concrete Mixer

The Blaw-Ransomixer here illustrated has full 10 cu. ft. capacity. The mixing is quick, due to the use of practically straight blades. These mixers have been in successful operation for over a year. The horsepower required to run the low charge type is 4 and that for the power loader is 6. The



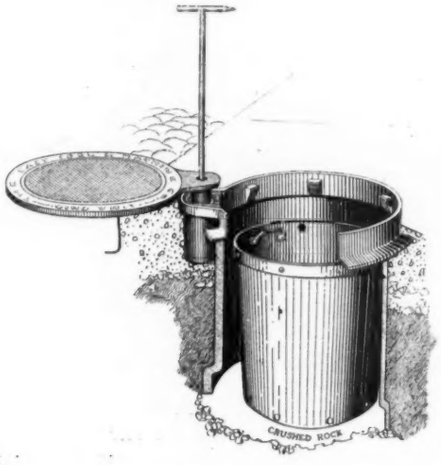
THE 10 CU. FT. BLAW-RANSOMIXER.

frame is of steel, with sills of 4 x 6¼-lb. channels, strongly braced. The overframe is of 3 x 3 x 3-16-in. angles, well gusseted and braced in both directions. The drum heads form a wide angle with the shell. The blades are straight and undercut in the direction of revolution, and are so set that the discharge from one blade falls on the back of the following blade, thus setting up a scouring action which keeps the mixer clean.

A Pivot Lock Cover for Sewers and Street Sweeping Receptacles

The "Ransenhousen Pivot Lock" cover, here illustrated, makes possible the prompt, economical and sanitary disposal of street sweepings during the daily process of cleaning the streets. The object of this device is to provide a place for the empty and full cans when not in use. These receptacles are flyproof and windproof and can be set into the sidewalk or street. They are protected by a locked cover which does away with all danger of liability from accidents to pedestrians. In practice these receptacles are evenly distributed throughout the beat of the sweeper and when he starts work in the morning he finds an empty can in each receptacle. He places one on his push cart and is ready to start cleaning up. After filling the first can he goes to the nearest receptacle, opens it with his key wrench and dumps his full can into the empty can that the receptacle contained, closses the receptacle cover, hangs his key wrench on his cart and goes on with his work without any waste of time. The time he saves in handling filled cans by this method enables him to clean a larger area.

At night a pick-up wagon or truck equipped with a swinging arm and a hoist comes around and backs up to the curb. The hoist is equipped with bale hooks, which are hooked to two bales on the inside of the cans. The cans are hauled out and placed on the truck and carted off to the dump, emptied and brought back and replaced in the receptacles for the push cart man or sweeper to use the next morning. The cans



PIVOT LOCK COVER AND SIDEWALK RECEPTACLE FOR STREET SWEEPING CANS.

are at all times protected from battering and should last much longer than under ordinary conditions.

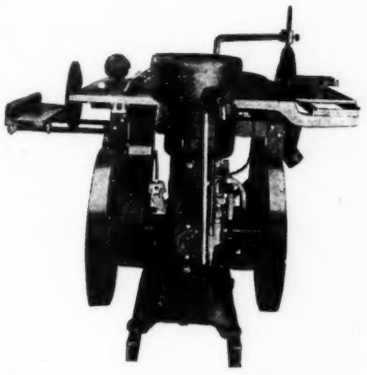
The "Ransenhousen Pivot Lock" cover, which is manufactured and marketed by the East Iron and Machine Company, Lima, Ohio, is also successfully employed on sewer manholes and wherever cover plates are used for any purpose.

A Portable Gasoline Sawing Outfit

Portable gasoline sawing outfits have long been in favor with contractors, especially where a large quantity of lumber is to be cut up for use in concrete forms. On the cantonment construction these portable sawing rigs made possible, as much as any other agency, the rapid construction progress attained. The portable sawing outfit, here illustrated, is the "Sultan" portable saw rig No. 3-B. In this unit a 7 h. p. "Sultan" engine furnishes ample power for the 14 to 16-in. saws and gives a diversified kind of work. Any skilled carpenter can operate this machine satisfactorily. It is claimed that the operating expense is very low. It will do the work of several men with hand saws. It is a combination machine, a combination of nine machines into one.

Builders soon learn to use the sliding cross-cut table and save 50 per cent. in time over the ordinary way of cross-

cutting, sliding the material through the saw rather than forcing the material into the saw. Perfect jointing is also possible and safely done on the jointer head, rabbeting, grooving is also accomplished on this machine without effort. Sanding, boring and ripping is also accomplished just as readily as cross-cutting and saving the time of five or six good men—a combined power driven nine-machines-in-one for the cost of a single outfit.



PORTABLE GASOLINE COMBINATION SAWING OUTFIT.

The "Sultan" saw rig is constructed of steel and iron, making it indestructible and long lived—a warping table top is unheard of on an iron table top. The frame is made of angles much stronger than wood and more serviceable, with large hot rivets, riveted under an air riveter and forced in a homogeneous mass of strong steel and iron.

Plant Units Used on Camp Green Cantonment Construction

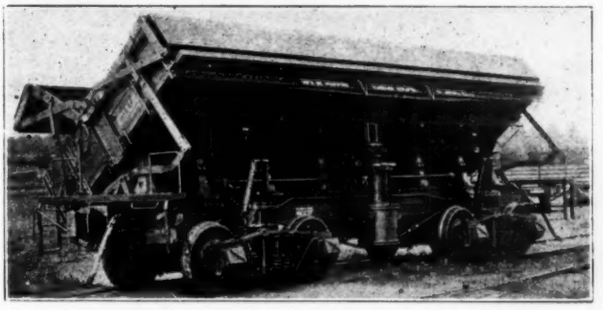
A great variety of construction plant units was utilized on the construction of the cantonments for the National Army and National Guard. Here is a list of the units employed by the Consolidated Engineering Company, of Baltimore, in the construction of National Guard Camp Green, at Charlotte, N. C.: Two 2-bag Lakewood concrete mixers; 32 1½-ton motor trucks; 1 No. 60 Marion steam shovel; 3 10-ton road rollers; 350 dump wagons of all kinds; 2 derricks; 15 6-h.p. portable Oshkosh saws; 5 12-bbl. Frick Manufacturing Company sprinkling wagons; 2 trench pumps; 3 road machines, and 2 Vulcan plows.

New Type of Dump Car for Heavy Service

A new type of dump car, here illustrated, has been perfected by the Western Wheeled Scraper Company. This car is designated as the Western Automatic Compression Lock. The dumping and righting of the car is accomplished by the use of two short-stroke vertical cylinders placed on either side of the car, the piston rods of these cylinders engaging with the underside of the bed through a hinged connection, called the push rod extension. The same general design of hinges and door operating mechanism is retained, which has proven so successful in Western cars for the last twenty years.

The features which are individual to this car are the means of unlocking, locking and controlling the position of the bed without the use of side chains or any fixed connection between bed and underframe. Owing to the very severe service required of these cars it was considered advisable to support the bed of the car in such a manner as to transmit the strains, due to dropping the heavy dipper loads, directly to the truck springs. This has been accomplished by using a strut, or post, hinged at the bottom end to the body bolster, the upper end being so designed as to follow, in a guide attached to bed, the motion of the bed, thereby positively controlling the motion of the strut.

In order to lock the car in carrying position a brace has been pivoted at the upper end of the strut, the lower end engaging with a cam, fastened to a rock shaft, which in turn is



WESTERN AUTOMATIC 20-YD. DUMP CAR.

operated by the movement of the piston in the cylinder. It readily will be seen that by this method all members between the bed and underframe are in compression, and the shock from loading is carried directly through the truck springs to the roadbed.

A Stone Spreader and Distributor

The Burch stone spreader and distributor is a labor saver. It spreads stone on roadways and obviates a fruitful source of labor shortage. The picture shows how the machine unloads and distributes. The spreader is provided with chains to hook to a motor truck. A gate at the rear of the spreader

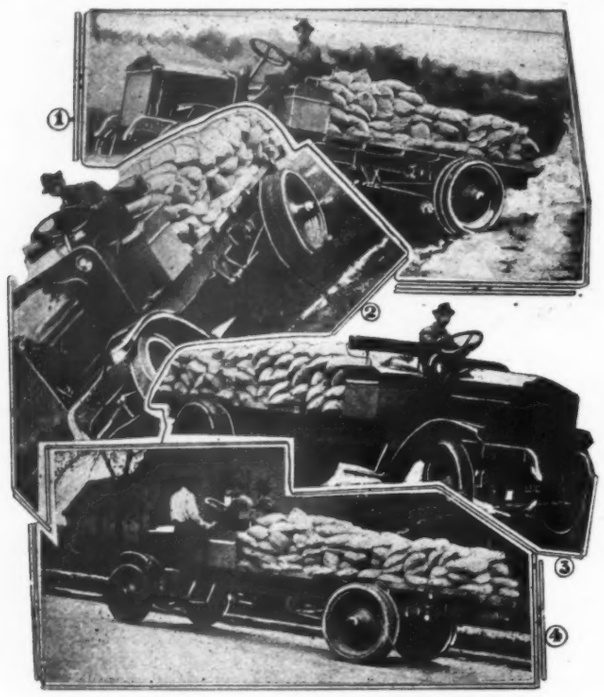
A NEW STONE SPREADER AND DISTRIBUTOR.

is adjustable to regulate the depth of stone. An even depth of stone distribution is secured. The machine is 7 ft. 4 in. long so it can be used in connection with any truck. Because of uniform spreading this machine saves material as well as labor. One contractor recently saved enough stone in two miles of road construction, it is claimed, to pay for his machine, while fully meeting the engineer's specifications.

A New Five-ton Motor Truck

A new 5-ton Titan motor truck, manufactured by the Titan Truck Company of Milwaukee, is built especially for contract trade. It is constructed throughout according to government specifications for large war trucks. It is said to be the first truck that ever made the Nineteenth street grade in Milwaukee under a capacity load. As a part of the test program the truck was loaded with five tons of concrete in bags. It climbed

the Nineteenth street hill, a 20 to 25 per cent. grade, 500 feet long, on first gear, with the governor holding the motor to a maximum of 1,000 r.p.m., without a falter. It is claimed that the Titan is the first American truck of the large internal

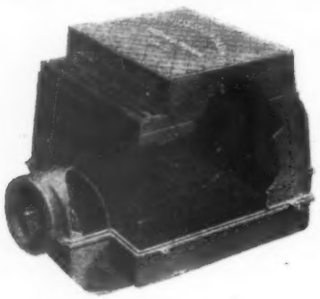


VIEWS OF THE TITAN TRUCK IN ACTION.

gear type to be fitted with radius rods. It has a road clearance of 16 in. under the solid rear axle. The transmission gears are shifted by dog clutches, making it impossible to strip or injure the gears. The chassis is built to carry more than its own weight, which tends toward economy in all directions. The views, herewith, show this new truck in action.

An Odorless Cast Iron Sanitary Catch Basin

The odorless, all cast iron, sanitary catch basin, here illustrated, is not an experiment. It has been on the market for the past five years, and within the last year it has been perfected in detail, and its sale is now being pushed. The odorless sewer basin costs somewhat more than brick or concrete basins, but it is claimed that this higher first cost is more than

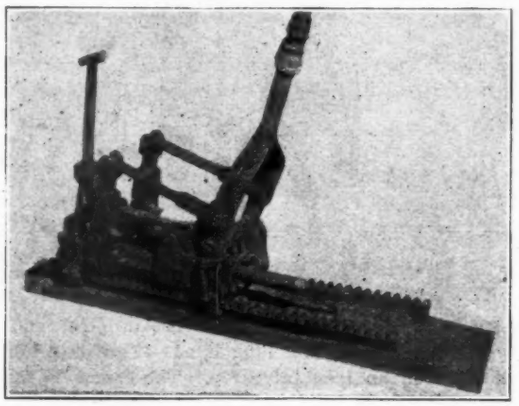


AN ODORLESS SEWER BASIN.

balanced by reduction of other costs. It is easily installed by any laborer, and is easily moved to meet grade or other changes. It is claimed that one man with a long-handled shovel can clean twice as many of these basins in a day as he cleaned of the old types of basins in ten days. The basin is constructed throughout of pure cast iron. The upper part, including street grating, is a separate casting, secured by lugs and bolts, so that any special design can be furnished to meet city requirements. This also allows the top to be turned so that the sewer connection can be run in any direction. It has a broad, flat bottom and is easily handled on rollers.

A Pipe Pusher That Saves Pavements

The Easy pipe pusher, here illustrated, puts pipe under ground with a minimum of digging and a minimum of damage to pavements. It is claimed that this device will put in from 30 to 150 ft. of pipe at any depth in an hour. It will push pipe under paving, floors, streams and other difficult places as



A DEVICE FOR PUSHING PIPE UNDER PAVING.

quickly and cheaply as in the open. The speed depends on the soil and the operator. The machine saves from 75 to 85 per cent. of the digging. In ordinary work it only requires a short ditch to set the machine to start. Where the pipe is to be pushed long distances, a small hole about 18x36 in. must be dug every 50 to 75 ft., to know the pipe was correctly aligned, and is going the exact direction desired. In working from a basement, 300 ft. of pipe could be put in by digging four or five holes a total distance of probably 12 ft. The distance between the holes depends upon the accuracy of the operator's eye. The pusher will work under pavement, walks, floors, streets or lawns. It will draw out old, damaged pipe, and replace with new; draw lead pipe and cable through under ground, or through conduit, after putting the conduit in. It will work any place digging can be done, and in some places where digging would be very difficult.

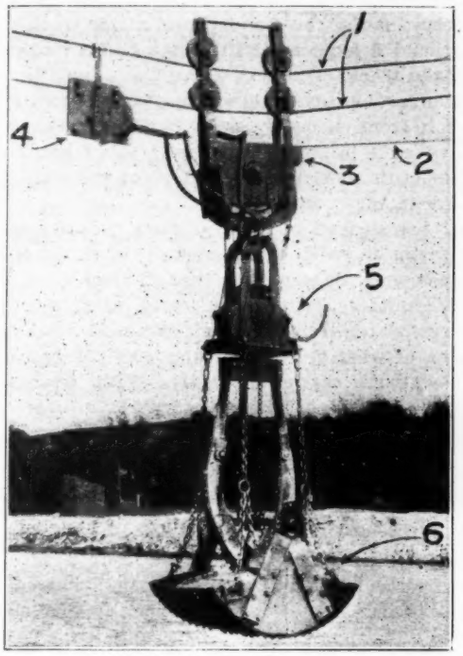
Clam Dredging Sand on Nebraska Rivers

Sand production by dredging on Nebraska rivers is carried on with drawline dredges and clam dredges. Clam dredgs are operated either by cranes or on double cables. About 20 dredges load sand in the state for eight months of the year. Most clam dredges operate along the lower Platte producing from the sandy alluvium where the stripping is thin and the water table is near the surface. They are located on railroad spurs which extend to accessible sand ground near the towns. The cost of a clam dredging plant, not including the railroad spur, is from $3,000 to $5,000. Rainy weather does not interfere very much with the operation of the plant.

The equipment of a dredge operating on a tram supported by towers is given by George E. Johnson, state engineer, as follows: Railroad spur, engine and engine house, towns and anchors for cables, double cable, carrier and block, clam dredge, draw line, scrapers, shovels, etc., for stripping and loading, and equipment for screening and grading.

Large towers are erected 200 ft. or more apart to hold the heavy cables upon which the dredge proper operates. The

tower at the dumping end of the cable is the higher. It is built of heavy timber. Strong cables connect from the upper ends of the towers with heavy anchors. These support the double cable or tram line. The clam dredge proper, here illustrated, weighs from 2,000 to 3,000 lbs. The numbered parts in the view are: 1, double cable; 2, draw line; 3, carrier; 4, trip block; 5, block head, and 6, clam shell. The clam dredge is built of heavy crucible steel. Its halves or clams are hinged



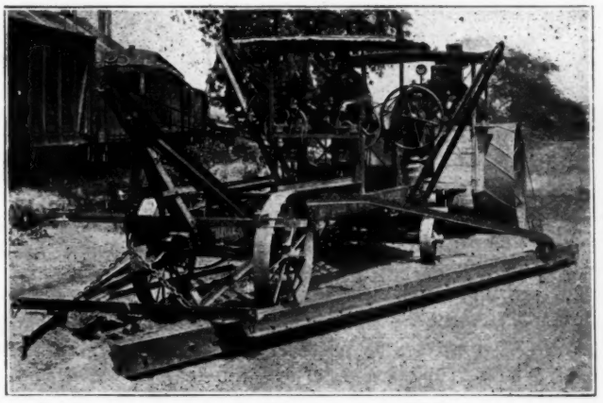
CLAM DREDGE USED ON NEBRASKA RIVERS.

to a steel bar about 3 inches in diameter and attached to a clam head by heavy chains and levers. The clam head, weighing about 500 lbs., contains strong pulleys through which passes a draw line cable about ¾ in. in diameter. A carrier, weight 1,000 to 1,500 lbs., runs on the double cable. The weight of the dredge, the block head, carrier and sand load is supported by the double cable.

When operating, the clam dredge, block head and carrier, run out on the double cable from the high tower to the trip block by gravity. Upon reaching the trip block the open clam and block head descend to and through the water to the sand. The block head lowers, strikes and catches the hinge bar and as the dredge starts to rise, the clam shells close in on the sand, scooping up a load weighing 2,000 to 3,000 lbs. or more. This load is carried upward to the carrier and trip, then to the high tower, where it is dumped into storage, into a washing and grading plant, or directly into a car. Working at the average rate, a dredge makes a trip in about 80 seconds, varying with the distance and depth of working. From 6 to 20 cars of 40 tons or more each are loaded at a plant in 8 to 10 hours.

A Self-Operating Road Leveler

The blades of the "Uncle Jim" self-operating road leveler are each 25 ft. long and 12 in. high and weigh 1,000 lbs. This Baker "Uncle Jim" road leveler grades any road up to 30 ft. in width in passing over it a single time. An ordinary 15 to 25 h. p. tractor developing the rated power on the draw-bar will handle this machine successfully on ordinary roads. One man easily operates the leveler. The blades can be worked independently. The blades can be drawn in for passing through narrow bridges. The machine can be easily turned around in its own length of 30 ft. The principal dimensions of the leveler are as follows: Length of main frame, 20 ft. 6 in.; distance between axles, 14 ft.; diameter of front wheels,

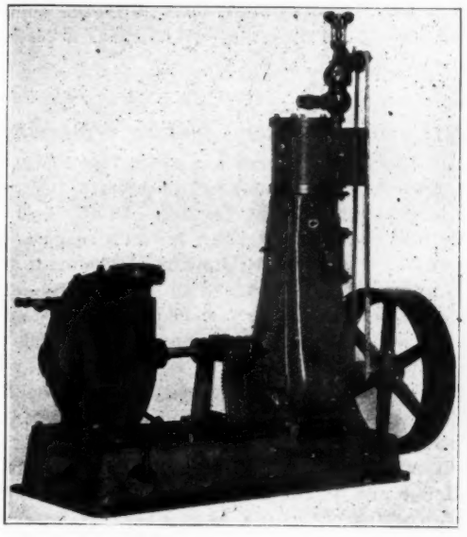


THE "UNCLE JIM" ROAD LEVELER.

24 in., and of rear wheels, 42 in.; width of tires, 6 in.; width center to center rear wheels, 4 ft. 8 in.; width center to center front wheels, 3 ft. 4 in.; weight of leveler about 6,300 lbs.

An Asphalt Pump for Paving Construction

A steam-jacketed, centrifugal asphalt pump for road builders is here illustrated. It is designed by Hetherinton & Berner to replace the air compressor and mechanical agitation in modern asphalt plants. The view shows one of these pumps direct-geared to a vertical automatic engine. The pump was especially designed for handling asphaltic cement and bitu-



A STEAM-JACKETED CENTRIFUGAL ASPHALT PUMP.

mens and oils of allied nature. It has removable heads on both sides. The pump may be assembled either right hand or left hand. It is easily applied to portable road asphalt plants, having any arrangement of kettles. Steam-jacketed asphalt pipe lines are obtainable for use with the pump.

Sewer and Conduit Rods

One of the conveniences of conduit and sewer operation which warrants frequent notice is that sold by Harold L. Bond Company, Boston, Mass., which has the Felton improved couplings. They do not separate under push or pull and the sections are short enough to handle easily in manholes.

DIGEST OF THE ESSENTIAL NEWS

Alabama Getting Ready for Federal Aid Road Construction

W. S. Keller, engineer of the Alabama State Highway Department, Montgomery, writes under date of October 13, as follows:

We have been busy during the current year preparing for Federal aid. By an act of the last legislature, approximately 3,000 miles of road, touching every county in the state, were declared state trunk roads. The same act made it illegal to use state funds on any other than a state trunk road unless all trunk roads in a county applying for aid were already constructed to the satisfaction of the State Highway Department. In case a county has its trunk roads all properly constructed, they may secure state aid for any other main traveled thoroughfare approved by the state engineer.

The government has made the same requirement as to the use of Federal aid. In order that every county in the state might have a fair chance to complete its trunk roads the State Highway Commission allotted Federal aid to an amount not to exceed $12,000 to each county. To date 25 projects have been submitted to the secretary of agriculture. Twelve have been approved, two disapproved and the remainder are being considered. By January 1 we expect to have actual construction work under way on at least 20 projects.

Labor is badly disorganized, but with the completion of work at the various army camps we hope for a betterment of conditions.

Governor Lowden (Illinois) Names Waterway Board

Governor Lowden of Illinois has given impetus to the deep waterway movement in Illinois by the creation of a board of water resource advisers. The personnel of the first board is a guaranty that the administration favors a seagoing channel. E. S. Conway of the Kimball Company, Joy Morton and John T. Pirie, the Chicago members, are all enthusiastic deep waterway promoters. George T. Page, a Peoria lawyer, and Charles B. Fox of East St. Louis, the downstate members, also are water route enthusiasts.

This new board, which will work under Leslie D. Puterbaugh, director of public works and buildings, and W. L. Sackett, superintendent of the division of waterways, will turn its attention first to obtaining a waterway connection between Joliet and the Illinois river at LaSalle. This is a step in the working out of the lakes-to-the-gulf waterway. Mr. Conway is a pioneer in the water route propaganda. It is Governor Lowden's desire to unite all interests in a common plan of waterway development and to this end he asks the cooperation of all civic bodies and citizens generally who have made a study of the subject.

The United States Liberty Motor Truck

The first Liberty motor truck, the product of the combined genius of 12 motor truck plants and 62 automobile parts factories, has been completed.

The standardized machine, of which 35,000 will be turned out the first half of 1918, represents the perfection of automobile development, the work of the greatest motor truck designers in the country.

The Gramm-Berstein Company of Lima, Ohio, was chosen to build the first model. Ralph Austin, engineer of the Gramm plant, is chairman of the standardized motor truck committee of the national defense committee, and had a leading part in designing the truck.

This standardized machine was built in the greatest secrecy to protect it from enemy eyes. A building without windows and lighted only by skylights housed the truck during the three weeks of its construction. The plant was closely guarded by armed men night and day.

Similar precautions surrounded parts manufactured in the sixty-odd factories which contributed to the machine. As each part was completed it was dispatched to Lima in charge of an army representative, who kept factory officials informed of his progress by telegraph. No one company knows the complete design or what other companies made other parts.

The new truck carries more than 1,000 pounds of dead weight more than commercial trucks of corresponding capacity.

A Unique Engineering Agency Created by United States Department of Labor

In normal times when an employer is in need of help he has only to post a notice in front of his establishment to secure the necessary help. At times, however, he requires men of special qualifications who are not only skilled mechanically but who also know the underlying principles of their occupation; that is, engineers (mechanical, electrical, civil, etc.). Suitable help of this character is not abundant, and is frequently quite scattered, hence much valuable time is lost to the employer and the available engineer in finding each other. A great need is some central office where available engineers could register, and where complete and up-to-date information concerning their qualifications could be kept on file. Employers, when in need of such help, could then report their needs to this central office with the assurance that that office was fully informed as to where suitable help could be secured.

Bringing Engineers and Employers Together

With this in mind the United States Department of Labor recently created, as a part of its employment service, a division whose function it is to aid the employer in obtaining suitable help and professional persons in securing suitable employment. This is known as the Teachers' and Professional Service Division. While intended to embrace all professions, attention has thus far been confined to the teaching and engineering professions. The services of the division are absolutely free to both employer and employe, all expenses being borne by the United States government. Its methods are quite thorough, and no service is rendered the applicant until the division has learned, from persons familiar with the applicant, that he is qualified as to training, experience and personal qualities for the position he seeks. When an applicant is recommended for a reported vacancy, the employer is given an opportunity to examine the data gathered in the course of this investigation, thus effectually preparing for the final and most important step, the personal interview, and for this ample facilities are provided in the offices of the division, where employers may meet with prospects on appointment.

The Service Is Free

Employers and professional engineers everywhere are invited to avail themselves of the services of this division, which,

as stated above, are entirely free. Employers in reporting positions are asked to state the nature of the position, its duties, requirements, etc., the probable salary and the probable duration of employment. Applicants for registration should indicate in the first letter the nature of the position desired so that the proper blank may be furnished. All communications should be addressed: Teachers and Professional Service Division, United States Employment Service, 845 South Wabash Avenue, Chicago, Ill.

Paving Brick Industry to Hold Conference in Cleveland

Out of war conditions—the breakdown of railroad and express companies to move crops and supplies and the extraordinary demand for better roads—the paving brick industry has been confronted with problems whose solution lies in study and conference on the part of all manufacturers. The annual meeting of the National Paving Brick Manufacturers' Association, to be held in Cleveland on November 19 and 20, will be the occasion of such a conference, to which are invited all manufacturers of paving brick.

The office board of the National Paving Brick Manufacturers' Association is convinced that more good to the country and to the industry can be effected by a conference in which the entire industry is represented by its active executive officials than by any other undertaking.

Experienced Highway Construction Men Wanted for Service in France

Men who have had experience in any branch of road construction are offered an opportunity to see early service in France in special road-building battalions of the United States army by recruiting plans here announced. These battalions will be required to repair and maintain the highways near the fighting front, over which tremendous traffic is operated continuously. They will also build new strategic highways in the war zone. Consequently, these troops, all volunteers, will be in the thick of the greatest activities.

The new battalions are constituted as regular military units and as a part of the regular army organization. They are fully armed and will be required in emergencies to fight along with the other troops. Generally, however, they will be occupied with road work.

The battalions will form a part of the 23rd Regiment of Engineers of the new national army. This regiment will eventually have a strength of about 10,500 men—more than an ordinary brigade—and will, so far as is at present known, be the largest in the army. It will be commanded by Col. E. N. Johnston of the Corps of Engineers, U. S. A.

Those interested should address: Commanding Officer, 23rd Engineers, National Army, 1419 F Street, Washington, D. C.

U. S. Chamber of Commerce for Military Roads

The following resolutions were adopted by acclamation at the recent War Convention of the Chamber of Commerce of the United States:

Whereas, it is essential that all transportation facilities of the nation should be brought to the highest state of efficiency in order that foodstuffs may be moved most economically from the farm to the market, that manufactured products be moved at the lowest cost from the factory to the consumer; and,

Whereas, the public highways offer a good, prompt and economical means to supplement transportation by rail and water; therefore, be it

Resolved, that the prompt improvement of our public highways is important and should be forwarded in every proper way.

ADVANCE INFORMATION ON BIG JOBS

The $25,000,000 Flood Prevention Project at Dayton, Ohio

Contracts for $10,000,000 worth of work on the $25,000,000 flood prevention project at Dayton, Ohio, will be let on November 15, 1917. This is the largest project of the kind ever undertaken.

Contracts 1 to 5 Inclusive—Dams and Appurtenances

Until 2 p. m., November 15, 1917, bids will be received for the construction of dams and appurtenances, as follows, at the office of the Secretary, Board of Directors, The Miami Conservancy District, Dayton, O.:

Contract No. 1—Germantown Dam and appurtenances, including Road No. 1, involving approximately the following principal quantities: Excavation, 200,000 cu. yds.; embankment, 850,000 cu. yds.; concrete, 20,000 cu. yds.; paving and riprap, 1,000 cu. yds.; iron and steel, 120 tons.

Contract No. 2—Englewood Dam and appurtenances, including Road No. 3, Road No. 4 and Road No. 5, involving approximately the following principal quantities: Excavation, 375,000 cu. yds.; embankment, 3,500,000 cu. yds.; concrete, 38,000 cu. yds.; paving and riprap, 2,000 cu. yds.; iron and steel, 180 tons.

Contract No. 3—Lockington Dam and appurtenances, including Road No. 8 and Road No. 9, involving approximately the following principal quantities: Excavation, 200,000 cu. yds.; embankment, 1,000,000 cu. yds.; concrete, 37,000 cu. yds.; paving and riprap, 1,000 cu. yds.; iron and steel, 50 tons.

Contract No. 4—Taylorsville Dam and appurtenances, including Road No. 12 and Road No. 13, involving approximately the following principal quantities: Excavation, 750,000 cu. yds.; embankment, 1,100,000 cu. yds.; concrete, 57,000 cu. yds.; paving and riprap, 5,000 cu. yds.; iron and steel, 400 tons.

Contract No. 5—Huffman Dam and appurtenances, including Road No. 16 to Station 60+50, and Road No. 17, involving approximately the following principal quantities: Excavation, 300,000 cu. yds.; embankment, 1,400,000 cu. yds.; concrete, 45,000 cu. yds.; paving and riprap, 1,500 cu. yds.; iron and steel, 400 tons.

Flood Control Works at Dayton and Hamilton

At the same time and place bids will be received on the following contracts:

Contract No. 41—Improvement of Miami River at Dayton, above Island Park, involving approximately the following principal quantities: Levee embankment, 65,000 cu. yds.

Contract No. 42—Improvement of Miami River at Dayton, Island Park to Washington street, involving approximately the following principal quantities: Channel excavation, 850,000 cu. yds.; concrete in retaining walls and revetment, 25,000 cu. yds.; levee embankment, 80,000 cu. yds.

Contract No. 43—Improvement of Miami River at Dayton,

Washington street to Stewart street, involving approximately the following principal quantities: Channel excavation, 465,000 cu. yds.; levee embankment, 205,000 cu. yds; concrete in retaining walls and revetment, 3,500 cu. yds.

Contract No. 44—Improvement of Miami River at Dayton, Stewart street to Broadway, involving approximately the following principal quantities: Channel excavation, 1,000,000 cu. yds.; levee embankment, 655,000 cu. yds.; concrete in revetment, 2,000 cu. yds.

Contract No. 45—Improvement of Mad River at Dayton, involving approximately the following principal quantities: Channel excavation, 20,000 cu. yds.; levee embankment, 35,000 cu. yds.; concrete in retaining walls and revetment, 1,500 cu. yds.

Contract No. 46—Improvement of Wolf Creek at Dayton, involving approximately 80,000 cu. yds.; levee embankment, 25,000 cu. yds.; concrete in revetment, 1,400 cu. yds.

Contract No. 58—Improvement of Miami River at Hamilton, involving approximately the following principal quantities: Channel excavation, 1,900,000 cu. yds.; concrete in retaining walls and revetment, 27,000 cu. yds.; reinforcing steel, 550,000 lbs.

Many Sub-contracts

The larger contracts to be let contain numerous smaller pieces of work for which the main contractor may not be equipped, and which he may desire to sublet. The chief engineer of the Conservancy District, Arthur E. Morgan, would be pleased to hear from any persons or firms who would be in position to take any of these subcontracts, and will put them in touch with those who will bid on the larger contracts as a whole. Some of the kinds of work which may be included in these subcontracts are:

Clearing and grubbing trees from base of dam. Soil stripping from base of dams, levees and borrow pits. Surface dressing and grassing of dams. Seeding or sodding of levees. Trimming slopes of river channels. Removal of buildings. Excavation for minor drainage systems. Construction of levees. Excavation and fills for highway construction. Rolled gravel paving for highways. Water bound macadam paving for highways. Street paving; bituminous macadam, brick, concrete, etc. Guard rails for highways. Construction of wire fences. Laying vitrified pipe. Gutter paving. Stone masonry. Stone paving. Riprap. Small concrete structures. Road culverts. Concrete slope revetment for river banks. Concrete blocks for slope protection. Setting flood gates in canals and sewers.

Information for Bidders.

The District has published a 50-page pamphlet, giving information for bidders, containing a list of the contracts, information for bidders, list of contract items and estimates of quantities. The information for bidders covers such matter as natural gas, coal, electric power, telephone service, freight service, sources of supply of sand and gravel for concrete, stone for stone masonry, rubble paving and riprap and flood warnings.

The Columbus Channel Improvement Job Involves Much Earth-Moving and Concreting

The Columbus (Ohio) flood protection work involves channel improvements which entail large earth moving and concreting operations. The earth excavation and fill amount to about 2,000,000 cu. yds. There is also a concrete overflow dam 20 ft. high and about 600 ft. long, a reinforced concrete levee wall 24 ft. high and 1,200 ft. long to serve as an emergency spillway, and a considerable quantity of reinforced concrete revetment paving. The entire job will be handled in one contract. The cost-plus method of awarding the contract may be used.

The channel widening extends over a distance of about two miles and represents a depth of cut averaging 20 ft. and is several hundred feet wide. There is no rock in the channel. The slopes of the new channel will be trimmed and seeded in grass. The material excavated will be used in building levee embankments along both sides of the channel. About half the excavation spoil will be moved downstream to form levees along a two-mile stretch below the section widened. The levees will be 80 ft. wide on top, at least. The one bridge included in the contract has seven arch spans, ranging from 78 to 105 ft., with deck width of 60 ft.

The work will all be done in the Scioto river, between the mouth of the Olentangy river and the Columbus sewage pumping station, a total distance of about four miles.

George A. Borden is director of public service and Henry Maetzel is city engineer. The estimated cost (made a year ago) is $1,750,000, but about $2,000,000 is available for the work, including the purchase of some real estate.

How the Contractors are Bidding

Bids on Sewer Construction at Menomonie, Wis.

Table I herewith gives the estimate of cost of sanitary sewer work in Menomonie, Wis., and the bids received on this work. We are indebted to C. E. Huntington, city engineer, for the bids and descriptive information given.

The average cut on the 18-in. vitrified sewer was 12 ft. and 8 ft. on the 15-in. and 8-in. sewers scheduled in Table I.

All excavation in second district was sand and gravel, making tight sheeting necessary. The sheeting was driven by hand and pulled by stone mason's derrick, operated by two men; all hand excavation.

First district was sand and gravel for 2,400 ft., with tight sheeting used under same conditions as given. Balance of 18-in. pipe and all 15-in. and 8-in. was laid in open ditch through

TABLE I—ENGINEER'S ESTIMATE AND BIDS ON SEWER JOB AT MENOMONIE, WIS.

Quantities	City Engineer's Estimate		R. R. Hunt Menomonie, Wis.		Cast Stone Constr. Co. Eau Claire, Wis.		Wm. C. Fraser St. Paul, Minn.	
First Cewer District—								
2,610 feet 18-inch Vitrified Pipe	$ 1.65	$4,306.50	$ 1.57	$4,097.70	$ 2.20	$5,742.00	$ 2.10	$5,481.00
730 feet 15-inch Vitrified Pipe	1.25	912.50	1.23	897.90	1.20	876.00	1.20	876.00
1,020 feet 8-inch Vitrified Pipe	.90	918.00	.94	958.80	.60	612.00	.70	714.00
8 Manholes	48.00	384.00	55.00	440.00	50.00	400.00	50.00	400.00
10 Catch Basins	48.00	480.00	55.00	550.00	35.00	350.00	50.00	500.00
Second Sewer District—								
661 feet 15-inch Vitrified Pipe	$ 1.25	$ 826.25	$ 1.18	$ 779.98	$ 1.35	$ 892.35	$ 1.35	$ 892.35
75 feet 8-inch Vitrified Pipe	.90	67.50	.94	70.50	.60	45.00	.75	56.25
2 Manholes	48.00	96.00	55.00	110.00	50.00	100.00	55.00	110.00
4 Catch Basins	48.00	192.00	55.00	220.00	35.00	140.00	50.00	200.00
		$8,182.75		$8,124.88		$9,157.35		$9,229.60

TABLE II—BIDS RECEIVED ON SEWAGE DISPOSAL PLANT AT STAMFORD, CONN., SEPT. 22, 1917.

Description	Quantity	Engineer's Estimate Unit	Engineer's Estimate Item Total	Frank Palmer Unit	Frank Palmer Item Total	Eaton, Brown & Simpson, Inc. Unit	Eaton, Brown & Simpson, Inc. Item Total
Protective Work and Royalties	Lump sum	.....	$ 5,500.00	.....	$ 26,500.00	.....	$ 31,268.00
Excavation	17,000 cu. yds.	$ 1.50	25,500.00	$ 1.25	21,250.00	$ 1.32	22,440.00
Rolling Enbankment	11,000 cu. yds.	0.20	2,200.00	0.65	7,150.00	0.29	3,190.00
Concrete	3,500 cu. yds.	16.00	56,000.00	21.25	74,375.00	17.25	60,375.00
Reinforcing Steel	200,000 lbs.	0.06	12,000.00	0.06	12,000.00	0.069	13,800.00
Cast Iron B. & S. Pipe	43.5 tons	75.00	3,262.50	75.00	3,262.50	103.60	4,506.60
Cast Iron B. & S. Specials	15.5 tons	115.00	1,782.50	80.00	1,240.00	189.00	2,929.50
Cast Iron Flanged Pipe and Specials	5.0 tons	150.00	750.00	90.00	450.00	262.00	1,310.00
Gate Valves	Lump sum	.....	600.00	.....	712.00	.....	791.00
Sluice Gates	Lump sum	.....	3,000.00	.....	2,327.00	.....	4,179.00
Check Valves	Lump sum	.....	225.00	.....	229.00	.....	350.00
6-in. Flap Valves	8 each	15.00	120.00	17.00	136.00	17.875	143.00
8-in. Flap Valves	2 each	25.00	50.00	20.00	40.00	40.00	80.00
4-in. Vit. Pipe	1,200 lin. ft.	0.15	180.00	0.25	300.00	0.20	240.00
6-in. Vit. Pipe	20 lin. ft.	0.20	4.00	0.35	7.00	0.41	8.20
8-in. Vit. Pipe	450 lin. ft.	0.35	157.50	0.75	337.50	0.50	225.00
10-in. Vit. Pipe	700 lin. ft.	0.45	315.00	1.25	875.00	0.66	462.00
Structural Steel	65,000 lbs.	0.09	5,850.00	0.07	4,550.00	0.109	7,085.00
Misc. Cast Iron, Wrought Iron & Steel	20,000 lbs.	0.15	3,000.00	0.06	1,200.00	0.185	3,700.00
Railings	480 lin. ft.	2.00	960.00	1.25	600.00	1.84	883.20
Screen Chamber Superstructure	Lump sum	.....	900.00	.....	5,700.00	.....	1,322.00
Laboratory Bldg. Superstructure	Lump sum	.....	7,500.00	.....	7,325.00	.....	9,883.00
Lumber	13 M. ft. B. M.	85.00	1,105.00	50.00	650.00	149.50	1,943.50
Baffles, including reinforcement	2,560 sq. yds.	2.75	7,040.00	1.00	2,560.00	3.51	8,985.60
Venturi Meter	Lump sum	.....	1,500.00	.....	1,650.00	.....	2,235.00
Chlorinating Apparatus	Lump sum	.....	1,400.00	.....	2,175.00	.....	1,557.00
Automatic Tide Gate	Lump sum	.....	500.00	.....	300.00	.....	575.00
Chemical Equipment & Piping	Lump sum	.....	2,500.00	.....	2,900.00	.....	3,644.00
2-in. Water Line	500 lin. ft.	0.70	350.00	1.00	500.00	0.575	287.50
Electric Hoists	2 each	350.00	700.00	532.00	1,064.00	583.00	1,166.00
Railways, steel ties, straight track	560 lin. ft.	1.25	700.00	1.46	817.60	1.46	817.60
Railways, wooden ties, straight track	600 lin. ft.	1.60	960.00	1.90	1,140.00	1.22	732.00
Railway, wooden ties, curved track	100 lin. ft.	2.25	225.00	2.00	200.00	1.725	172.50
Switches	9 each	60.00	540.00	70.00	630.00	75.00	675.00
Tip Cars	2 each	140.00	280.00	195.00	390.00	204.00	408.00
2-in. Water Line in Settling Tanks	Lump sum	.....	850.00	1.00	1,366.00	.....	1,119.00
Crushed Stone, Sludge Beds	770 cu. yds.	2.00	1,540.00	2.75	2,117.50	2.59	1,994.30
Macadam	1,600 sq. yds.	1.25	2,000.00	1.00	1,600.00	1.78	2,848.00
Pressure Water Pump & Motor	Lump sum	.....	500.00	.....	650.00	.....	632.00
Connecting Existing Pumps	Lump sum	.....	300.00	.....	500.00	.....	287.00
Fence	865 lin. ft	0.50	432.50	1.25	1,081.25	0.52	449.80
Total			$153,279.00		$192,857.35		$199,699.30

clay-gravel material and no sheeting necessary. The original estimate and all contractors figured on hand digging.

Manholes and catch basin of brick with 6-in. concrete floor and cast iron covers of city engineer's own design, made in local foundry.

Bids Received on Stamford, Conn., Sewage Disposal Works

Table II herewith gives a schedule of the bids received on the sewage disposal plant contract at Stamford, Conn., on September 22, 1917.

In addition to the bids scheduled the Suburban Engineering Company proposed to do the work at cost plus $12,500. The engineer's estimate was made in May, 1917, using the prices in force at that time.

Fuller & McClintock, 170 Broadway, New York city, were the consulting engineers on this job, and we are indebted to them for the information here given. Paul Nash is city engineer of Stamford.

Bids on Deep Well and Pump at Cuba City, Wis.

Bids were received on a deep well and a deep well pump at Cuba City, Wis., on July 12, 1917. The information here given was submitted by J. G. Thorne, civil engineer, Clinton, Iowa, who was consulting engineer on the job.

Specifications and Bids on Well

The specified sizes and depths of the well were as follows: The bore shall be 12 in. for 250 ft. and 10 in. for 500 ft. The 250 ft. of 12 in. shall be cased with standard wrought iron pipe; the pipe shall have an actual inside diameter of 12 in. and outside diameter of 12¾ in. and shall weigh 49 lbs. per lineal foot. The pipe shall be lap-welded and provided with a forged steel shoe and a proper head for driving. The intention is to case the new well below the bottom of the present well and prevent the present supply from flowing into the new well. The balance of the well shall be a 10-in. hole, through the solid rock, approximately 500 ft.

Two bids, each at $10 per foot, were received for the 250 ft. of 12 in. cased well. These bids were submitted by W. L. Thorne & Co. of Plattville, Wis., and M. T. Peterson of Madison, Wis. The first named contractor bid $4.50 per foot for the 10-in. well hole and the second bid $5.50 per foot.

Specifications and Bids on Pump and Motor

The deep well pump shall have a standard brass-lined working valve, double acting, with removable plunger with brass or bronze ball valves, 24-in. stroke and fitted for insertion into a 12-in. standard wrought iron well casing. The capacity of the pump shall be not less than 294 gal. per minute and shall operate at a piston speed of 100 ft. per minute. The pump cylinder will be approximately 200 ft. below the surface and shall pump against a head of 150 ft. above the curb.

The pump head shall be of a heavy type, adjusted for a stroke of 24-in. and shall be so arranged that it can be easily shifted to one side in case it becomes necessary to draw the pump rods.

The contract for the deep well pump and pump head shall include all necessary fittings to the well casing, check valves, gate valves, pressure gage, air chamber, sucker rods, drop pipe, belt, tight and loose pulleys and foundation bolts, and any and all accessories and fittings which may be necessary to complete the pumping unit within the station with the exception of the motor and wiring.

The motor shall be slip-ring, 30 H. P., 850 r.p.m., 3 phase, 60 cycle, 8 pole, 220 volts and one of the following makes: General Electric, Westinghouse, Wagner or Century.

W. L. Thorne & Co. of Plattville, Wis., bid $4,240 for the deep well pump and pump head in place, and $765 for the motor in place. They bid on a Downie pump and a 35 H. P. General Electric motor. Their bid for pump and motor was $5,005. They were awarded the entire contract at $9,755.

Other total bids received for pump and motor were: $5,286 by M. T. Peterson of Madison, Wis., for a Downie pump and $6,223 for an American pump; $5,170 by John W. Hildred & Co. of St. Paul for a Downie pump and 35 H. P. General Electric motor, and $5,130 by the Western Pump and Machinery Co., St. Paul, for Hannegan pump and 35 H. P. G. E. motor.

LIGHTS AND SHADES

Confusing the Public

Engineers are constantly complaining that they are not properly understood and appreciated by the public, and at the same time they write stuff like this: "Engineering is a mode of thinking. Any man who considers all his problems without prejudice, who clearly discerns the facts from the opinions—the essentials from the non-essentials—and who searches continually for new truths and better methods, who is not controlled by superstition or precedent, who analyzes constructively or constructs analytically, is an engineer. His field work may be medicine, law, architecture, agriculture, mining, merchandising, machine design or chemical research." Is it any wonder the confused citizen plays safe and thinks of the original engineer as the man who ran the donkey engine in Noah's ark?

Kindred Spirits

A contractor who believed himself to be the sole survivor of a shipwreck upon an island inhabited by cannibals, hid for three days in terror of his life. Driven out by hunger, he discovered a thin wisp of smoke rising from a clump of bushes inland, and crawled carefully to study the type of savages about it. Just as he reached the clump, he heard a voice say: "Why in hell did you play that card?" He dropped on his knees, and, devoutly raising his hands, cried:

"Thank God, they are Christians!"

Old Stuff

Vitruvius, who was an architect and engineer in the time of Julius Caesar, wrote as follows regarding the qualifications of an engineer:

"An engineer should be ingenious and apt in the acquisition of knowledge; he should be a good writer, a skillful draftsman, versed in geometry and optics, expert in figures, acquainted with history, informed in the principles of natural and moral philosophy, somewhat of a musician, not ignorant of the sciences, both of law and physics, nor of the motions, laws and relations to each other of the heavenly bodies.

"Moral philosophy will teach the engineer to be above meanness in his dealings and to avoid arrogance. It will make him just, compliant, and faithful to his employer, and, what is of the highest importance, it will prevent avarice gaining ascendency over him, for he should not be occupied with thought of filling his coffers, nor a desire of grasping everything in the shape of gain, but by gravity of his manners and a good character should be careful to preserve his dignity."

You will now stand corrected.

The Dramatic Bricklayer

Otis Skinner, the actor man, tells a story in support of the theory that the poetic spirit is sometimes contagious. A Shakespearean company was rehearsing for an open-air production of "As You Like It" near Boston, and the garden wherein they were to play was overlooked by a rising brick edifice. As the players recited their lines, the workmen continued to lay their bricks. One afternoon, during a silent pause in the rehearsal, the players were startled to hear a voice from the building exclaim with the utmost gravity: "I prithee, malapert, pass me yon brick."

The Busy Wop

An Italian, having applied for citizenship, was being examined in the naturalization court.

"Who is the President of the United States?"

"Mr. Wils'."

"Who is the Vice President?"

"Mr. Marsh'."

"If the President should die, who then would be President?"

"Mr. Marsh'."

"Could you be President?"

"No."

"Why?"

"Mister, you 'scuse, please. I vera busy worka da mine."

The Engineer's Favorite

Six engineers have told us this one, so it must be good. The division engineer sent the rodman, with level and rod, to catch the 8:05 a. m. train out to that day's work. The engineer followed closely and met the breathless rodman rushing back to the office. "Good God," said the rodman, "we forgot the plumb-bob!"

A Natural Scientist

An engineer, visiting his boyhood home, met the father of his colored schoolmate. The father, in reply to an inquiry concerning his son, said: "Why, that boy has turned out something wonderful. He is a great natural scientist. Yes, sir, a great natural scientist. Oh, he just picked it up. It seemed to come natural to him. Why, that boy has painted signs on every road leading into this town!" The engineer later saw the signs and agreed that the colored man had just "picked up" the art of sign painting.

Remember Ben Gunn?

Do you remember Ben Gunn, one of Stevenson's pirates, who was scandalized at the recollection of and who traced his downfall to "playing chuckoluck on the blessed gravestones?" Ben's descendants have gone him at least one better. It is reported that tombstones are not infrequently employed in different parts of England for paving purposes. Some four or five years ago the inhabitants of Belvoir bitterly protested against the use of such material in the construction of a road leading to the parish church, despite the assurances of the local authorities that with the liberal supply of old and broken gravestones at their disposal, the plan had been adopted with a view to saving the taxpayers quite a sum.

Telephones Unknown in Rural Ireland

Patrick, lately over, was working in the yards of a railroad. One day he happened to be in the yard office when the force was out. The telephone rang for some time, before Pat came to the conclusion that it ought to be answered. He approached the instrument cautiously, and slowly put the transmitter to his mouth, as he had seen the "boss" often do.

"Hillo, there," he called.

"Hello," answered some one at the other end, "is this eight-six-ought-four-eight?"

"Aw, g'wan; phat d'ye think Oi am, a box car?" replied Pat.

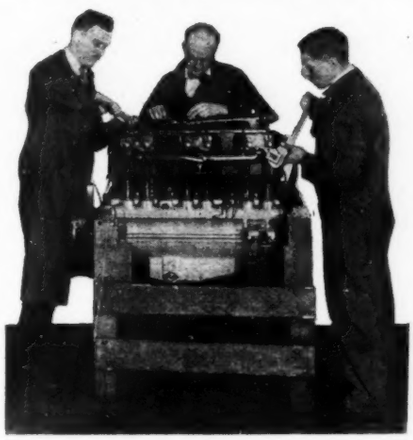
SALES ENGINEERING

How the Pierce-Arrow Motor Car Co. Trains Automobile Salesmen

By Harold H. Hodge, Manager of the School for Salesmen of the Pierce-Arrow Motor Car Company.

The Pierce-Arrow sales school is proving to be of great importance in the development of the Pierce-Arrow selling organization. There are few men in the industry today who appreciate the system the company employs in training men to sell pleasure cars and trucks. It may be said that the company now endeavors to use the same care in training its selling force that it uses in the manufacture of its products.

If the selection of perfect material with which to build trucks and automobiles is of prime importance in the manufacturing end of the business, the selection of perfect material from which to build salesmen is certainly of no less importance in the commercial end. It is the first aim of the Pierce-Arrow Motor Car Company to select men of the caliber, experience and qualifications which promise success for themselves as well as for those of our agents who may wish to employ them on the completion of their course of training.



STUDENTS DIS-ASSEMBLING MOTOR IN PIERCE-ARROW SALES SCHOOL.

How the School Is Organized

The school is designed to give prospective salesmen instruction in four requisites deemed fundamental:

First, a thorough understanding of the Pierce-Arrow tradition and policy and an absorption of the Pierce-Arrow spirit which creates the enthusiasm and confidence without which a salesman cannot succeed. Second, mechanical knowledge. Third, transportation problems. Fourth, sales knowledge, methods and arguments.

Pierce-Arrow Spirit

We believe every Pierce-Arrow salesman who has an understanding of the policy and traditions of this institution and our methods of business will have an enthusiasm and loyalty for the organization which will be reflected in his work.

With this in mind, the school is given the history of the institution, quantities of its literature, past as well as present, and talks pertaining to policy by executives.

Occasional talks not directly related to selling problems are given when it is believed they serve to convince the salesman of our steadfast adherence to our ideals and traditions. This is all on the assumption that a salesman cannot sell until he himself is sold.

Sales students are also taught where, how and in what respect the factory is prepared to lend a hand to our agents and their salesmen in convincing prospects—the use, for instance, of photographs, statistics, special data, etc.

Mechanical Training

A large, well lighted room called the sales school mechanical department is devoted to truck and pleasure car components, such as motors, transmissions, frames, rear axles, steering columns, etc., each on its own bench. In another equally large room, known as the students' lecture room, instructions are given on lines similar to those of a college course.

Virtually every production, service, factory and selling official with the Pierce-Arrow organization is included in the schedule of lectures.

Each week's schedule contains its quota of mechanical work, mechanical lectures, trips through the factory and quizzes. The various automobile units mentioned above are turned over to groups of two or three students for disassembling under instruction. This takes about one week for each unit. The function of the parts are thoroughly explained. The various methods employed by other manufacturers are discussed, materials, clearances, etc., are noted and the various selling arguments of the particular units are dwelt upon. Each group then reassembles its unit and proceeds to the next, thus progressing through each unit until the final assembling of the chassis. The students are required to do all the work themselves according to a prearranged system.

In connection with this mechanical education trips are made through various departments of the factory. Students are, for example, shown how Pierce-Arrow wheels are built, how the aluminum bodies are constructed, etc. These trips cover a dozen or more departments.

An important feature of the mechanical education is the series of lectures given by the Pierce-Arrow engineers and the heads of the various factory departments.

The mechanical part of the lecture course covers such subjects as the following: Differentials, wheels, ignition, magnetoes, leather and upholstery, pleasure car rear axles, truck rear axles, pleasure car engines, truck engines, truck engine materials, pleasure car engine materials, power equipment as applied to our trucks, five-ton truck, two-ton truck, pleasure car front axles, truck front axles, the steering column; how our experimental department protects the customer against mistakes in construction; electrical equipment for trucks, electrical equipment for pleasure cars, six, eight and twelve-cylinder engines, standard truck bodies.

These are but a few of the technical subjects upon which engineers and experts speak. A fair knowledge of competitive mechanical features is not overlooked, and their respective merits and deficiencies are explained.

Transportation Problems

A real truck salesman realizes that he is not selling a truck, but transportation. As a piece of machinery the Pierce-Arrow truck is high priced; as a method of transportation it is extremely low in cost. At first this sounds like "begging the question" of price; but it is only as a student acquires a knowledge of transportation problems that he can realize that (with its small depreciation, its great dependability and free-

dom from repairs and because of its long life) the Pierce-Arrow motor truck as an investment covering a number of years is very economical. These are points of value in proportion as they are made specific. Salesmen are taught, for example, if they are selling a coal dealer, these points and others should be made to fit precisely with the prospect's coal business. With this idea in mind the student is taught the transportation end of the coal business. This is accomplished in part in the classroom, but it is chiefly acquired by the student himself who is permitted a week's investigation of the transportation end of the coal business of one of the many owners of Pierce-Arrow truck fleets. During this week he rides on Pierce trucks, notes loading and unloading time, number of trips, running speeds, loading methods, number of stops, accounting methods, traffic conditions, etc. The result of this intimate knowledge of coal transportation problems thus acquired shows up in his efforts at selling coal dealers. He talks to his

ASSEMBLING 2-TON TRUCK MOTOR; AT LEFT, TIMING ENGINE; AT RIGHT, FITTING WATER PUMP; IN FRONT, MOUNTING CARBURETOR.

prospect from the latter's viewpoint. He sells a transportation method (which is what his customer wants) while his competitor very probably is trying to sell a truck (which is an expensive piece of complicated machinery which the prospect does not want to buy, but which is incidental to getting his transportation problem correctly solved). This study of transportation problems applies not only to the coal trade, but to various other lines of industry as well, such, for instance, as sand and gravel, brewing, contracting, general haulage, etc. Unfortunately no one salesman can afford the time for the study of the transportation problems of all lines of industry, but a representative number is given each man depending upon the nature of the field in which he is ultimately to work.

Sales Methods, Arguments, etc.

Before the inauguration of this sales school arguments used in selling Pierce-Arrow pleasure cars and trucks were as varied as the personalities of the salesmen. Each man's arguments and methods were based upon his individual experiences. Between two men of equal ability there existed wide differences of method.

An accumulation of information as to how the most successful salesmen accomplished their results is benefiting all other salesmen of the organization. A knowledge of the strongest arguments and the best methods are now being accumulated and dispersed through the sales school, which has become a clearing house for this material. This has proven of value not only to students but also to all those experienced and successful salesmen of all Pierce-Arrow agents who are alive to the opportunities it affords. Selling arguments on every feature of our trucks and pleasure cars are given to the sales students. Each is required to present his arguments in his own way. No sales argument is required to be rendered verbatim, as each student is encouraged to develop his own individuality.

Students are required to speak on their feet before others. "Speaking on your feet" is simple compared to "thinking on your feet." To develop this latter extemporaneous subjects are thrust upon the students who are also subjected to objections and contradictions. Mock sales are conducted, students taking turns as prospects and salesmen.

Mental initiative is encouraged in the students by requiring them to think out methods of their own and prepare sales arguments for themselves.

The lecture course of the sales end of the training is of the greatest value. This will be appreciated by a reference to the following partial list of subjects: Pierce-Arrow quality, general factory policy, mixing and business success, selling Pierce-Arrow motor cars, truck talking points, cumulative effect of intelligent methods, salesmanship from the buyer's point of view, truck salesmanship as a profession, transportation costs as selling arguments, some successful methods of selling, salesmen from the agent's point of view, modern automobile salesmanship, closing the sale, barriers to the sale and how to conquer them, getting prospects, price arguments, cost and depreciation, talking points for the pleasure car, high lights on truck selling, Pierce-Arrow service, selling fleets, inferences drawn from our sales distribution chart, the use of personal letters.

This series of lectures is augmented by talks by successful salesmen, many of whom talk informally to the class on their methods. A very complete course of lectures is also given comparing Pierce-Arrow with other makes—one talk upon each of the other types of truck or pleasure car.

How Students Are Enrolled

Prospective students are required to fill out a formal "application blank" in which is detailed confidential information. An interview is then arranged and the applicant, if accepted, is enrolled for membership in the next succeeding class. Students are paid during their course of training.

Unusual opportunities are afforded to men of the right caliber, ability, education and experience, especially at this time, when agents are losing so many good men because of the army draft.

Salesmen You Ought to Know

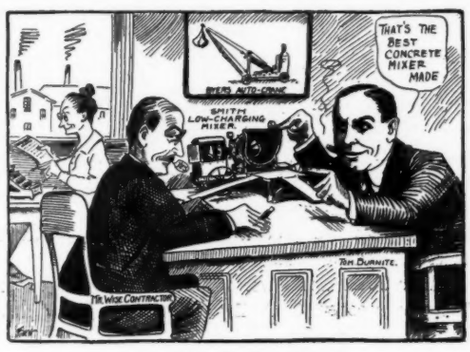
"Sales engineering," says Arthur W. Greetham, Manager of Excavator Sales for the Pawling & Harnischfeger Company, of Milwaukee, "consists of knowing your product thoroughly and neither overselling nor underselling your customer. In other words, in the line of machinery I have been handling I have never attempted to sell a customer a trench excavator just because that was my line and the only thing I could offer him when he positively needed steam shovels. The same rule would apply to the mixer line. The salesman selling this equipment should be familiar enough with the contracting game and his product to advise his customer whether he should have two small mixers or one large one to produce the most profit on the job. Salesmen lose customers for their concern as well as the prestige of their house in the contracting field by either overselling or underselling the purchaser. This phase of salesmanship has been properly termed a 'curse'." Mr. Greetham represented the Buckeye Traction Ditcher for

four years before entering upon his three-year engagement with P. & H. He modestly claims the United States as his territory; and, believe us, he covers it well. His hobby is talking motor trucks with old man Dickens of this publication. He is

ARTHUR W. GREETHAM.

one of those rare salesmen who not only Sunday at home but who go to church. He has only one child, but says, "Look at that one!" The little lady is here pictured with her daddy.

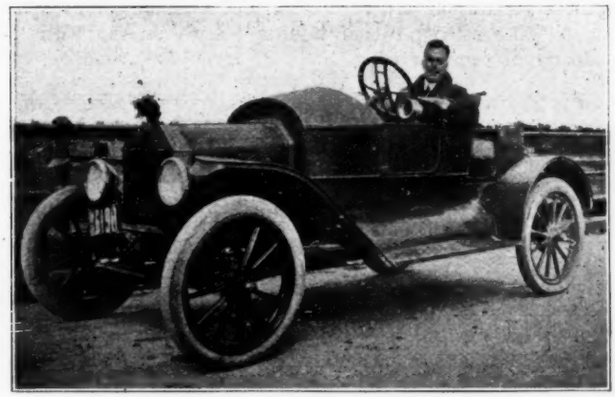
Here is a sketch of a veteran salesman in action. He has the contractor admitting that the Smith Low-Charging Mixer is the best ever. This is a typical pose and situation in the business life of Thomas B. Burnite, 523 Boston Building, Denver, Colo. He has represented a lot of lines and for a long time. His service record is: T. L. Smith Company, seven years; Smith Engineering Works, seven years; Erie City Iron Works, nine years; John F. Byers Machine Company, one year;



THOMAS B. BURNITE.

The Parsons Company, six months; Chicago Pneumatic Tool Company, five years; Kimball Elevator Company, seven years; Toledo Bridge and Crane Company, five years, and Spencer Turbine Cleaner Company, five years. He covers Colorado, Wyoming and New Mexico. These are sizable parcels of land lying west of New Jersey. His hobby is selling contractors equipment. The pen sketch was made by Frank Finch, the famous cartoonist of the Denver Post and the Kansas City Post. Burnite says his stenographer has more class than the old bird Finch has shown in the sketch.

Yes, they have hustling salesmen on the other side of that imaginary line dividing us from our Canadian cousins and friends. Mr. Douglas Robb, of Winnipeg, Manitoba, is that kind of salesman. Can ony one doubt it when they look at this picture showing him at the wheel of his 1909 Ford, which



DOUGLAS ROBB.

he admits is the oldest car in Manitoba? He is a star salesman of the first magnitude and handles London concrete mixers, domestic contractor's equipment and Condor belting. He travels from Port Arthur, Ontario to Edmonton, Alberta. He is a great fisherman—fish mad, his friends say. He built himself a log fishing lodge on Crystal Lake, Ontario, and tries to take all his customers fishing.

George Entrekin, of Pittsburgh, Pa., has learned many things in the course of his long and more or less eventful life. He says that the majority of salesmen have always been under the impression that they know more than their contractor customer and even the college bred engineer, and have had many sad awakenings. Mr. Entrekin is shown at the right-hand flag pole in the picture—he calls this picture "Looking them over." These boys are not all his sons. Five of the group have enlisted, and two are already in France. To the left of the group is another kind of scene, the title of which

GEORGE ENTREKIN.

is "Her'n." Two weeks every December he spends in the mountains of Pennsylvania, hunting deer and bear—on the square deer. He usually takes some of his competitors along on these trips. He finds them to be the very best of friends, as while they lie about his goods they refuse to lie about him. He has had much practical experience with both steam and

internal combustion engines, also electric lighting plants. His friends call him an expert, though he denies the allegation. He hasn't reached the half-century mark yet, but the last figure of his age is twice the first. He had twelve years in the theatrical business, four short, pleasant years with the Fairbanks Company at Pittsburgh and ten years (plus) with the Standard Scale and Supply Company, of Pittsburgh. Since Oct. 1 he has been located at 605 First National Bank Building, Pittsburgh, and has associated with him able and capable men, experts in their line, embracing scales, contractors' and road machinery, and one especially well educated on heavy motor trucks. The selling corporation is known as the Entrekin Company, at your service.

PERSONAL ITEMS

The roster of men in Companies B, C and D of the 108th Engineers (1st Ill.), U. S. N. G., who formerly held civilian engineering positions, is here given with their present rank and their former positions:

Company B—Capt. Benjamin C. Allin (civil engineer, C., R. I. & P. Ry.); Joseph C. Arey (electrical engineer, Cadillac Auto Co.); Walter J. Barrow (rodman, Santa Fe Ry.); Sergt. Clarence R. Braun (mechanical engineer, J. G. Braun, Chgo.); Charles F. Butler (electrical engineering student); Francis A. Cole (draftsman, Sargent & Lundy Co.); August T. Drom (construction division, Wisconsin State Highway Dept.); Alfred R. Edwards (chem. eng. student); Corp. H. W. Eshelman (arch. draftsman); Walter R. Faust (architect, N. Dunning); Harry S. Cutmore (valuation engineer); Louis F. Fisher (student, Armour Inst.); Corp. Albert G. Ford (asst. engr., W. E. Deutchler, Aurora, Ill.); Sergt. R. H. Forsythe (struc. draftsman, Universal Portland Cement Co.); Lewis Harper (draftsman, Rock Island Ry.); B. J. Herman (arch. estimator); First Lieut. L. J. Hughes (civil engr., C., R. I. & P. Ry.); Corp. E. J. Tilfoyle (eng. student, Armour Inst.); Corp. W. B. Kirkland (elec. draftsman, Western Elec. Co.); H. A. Long (civil engr., C. & N. W. Ry.); Corp. Oscar Laster (civil engr., Universal Portland Cement Co.); H. B. McClintock (civil engr.); Corp. J. McGee (eng. dept., C., R. I. & P. Ry.); Corp. Elmer H. Meinke (civil engr., C., B. & Q. Ry.); W. B. Mercer (draftsman, Gifford-Wood Co., Chgo.); L. V. Okerberg (draftsman, Poole Bros., Chgo.); P. A. Olson (draftsman, Ronneberg & Pierce, Chgo.); J. G. Ritter (arch. engr., Geo. A. Fuller Co.); L. H. Robertson (civil engr., I. C. Ry.); E. L. Salisbury (inspector, M. C. Ry.); Sergt. W. J. Savage (student, Armour Inst.); H. G. Schultz (draftsman); N. J. Schutz (eng. student); Geo. Shervington (civil engr., General Concrete Const. Co., Chgo.); A. L. Smith (mech. engr.); Sergt. F. E. Smith (eng. draftsman); Corp. A. F. Stoal (eng. draftsman); Sergt. G. S. Swanson (mech. engr.); Corp. G. B. Vernier, Jr. (mech. draftsman); T. R. Wirvi (elec. engr.); R. V. Williams (elec. engr.); K. R. Wilson (engineer, Stone & Webster); H. M. Wood (civil engr., Chgo. Union Sta. Co.); R. E. Zimmerman (draftsman, C., B. & Q. Ry.).

Company C—Capt. Harmon Laughlin (civil engr., Ewing & Allen, Chgo.); Second Lieut. Harry L. Hudson (engineer); First Lieut. Harry A. Roe (mech. engr., Pullman Co.); Chas. E. Cameron (draftsman, Crane Co.); J. Campbell (Ry. const. engr.); Geo. M. Davis (civil engr., U. S. Govt.); L. J. Hague (asst. engr., Vermont Steel Co.); Sergt. H. V. Hume (asst. engr., V. B. Roberts); C. R. Jones (surveyor, Westinghouse-Church-Kerr Co.); James Koca (auto draftsman); E. A. Martin (asst engr.); Sergt. N. A. Meyer (civil engr., C. & N. W. Ry.); Sergt. D. R. Norris (valuation engr., I. C. Ry.); Corp. L E. Perry (draftsman, Cont. Bridge Co.); L. A. Schalk (draftsman, Western Elec. Co.); Sergt. R. H. Smith (draftsman, Chgo. Telephone Co.); R. Stoesser (draftsman); R. E. Sullivan (const. engr., Leonard Const. Co.); A. A. Weston (asst. engr., C. & N. W. Ry.); L. H. Yurachek (draftsman).

Company D—Capt. Albert H. Sheffield (const. engr., Am. Terra Cotta Co.); Lieut. Leon R. Gurley (est., Am. Terra Cotta Co.); Lieut. Frank R. Stauffer (const. engr., C. P. R. R.); L. H. Abbott (draftsman); E. M. Bauernfiend (draftsman); W. J. Borucki (draftsman); N. C. Bradley (draftsman); Sergt. Clinton S. Darling (civil engr.-editor); Sergt. G. E. Dyson (const. engr.); Corp. R. F. Fields (civil and Efficiency engr.); Sergt. C. J. Frankel (sales engr.); R. V. Gustafson (draftsman); Paul Hosman (const. engr.); F. J. Impey (draftsman); H. W. Julison (draftsman); J. I. La Velle (const. engr.); W. L. McNamara (mech. engr.); W. Madsen (draftsman); Clyde Maze (map draftsman); Geo. Niemy (draftsman); W. G. O'Neil (const. engr.); Sergt. W. M. Parkhurst (eff. engr.); Sergt. H. C. Peters (architect); P. B. Rudolph, Jr. (supt. of const.); W. A. Schmidt (eng. student.).

Frank M. Gallagher, of Butte, Mont., has been appointed engineer of the Montana Public Service Commission at Helena.

F. M. Randlett, formerly of Lawrence, Mass., has been appointed chief engineer of the Water Bureau of Portland, Oregon, to succeed D. D. Clark, who left the position because of ill health, after 20 years of conspicuous success. It was under him that the present $14,000,000 system was developed. Mr. Randlett has been principal assistant engineer to Mr. Clarke for 11 years.

J. F. Mangold, city engineer of Grinnel, Iowa, and professor of civil engineering at Grinnel, has accepted a like position at the South Dakota State School of Mines at Rapid City, S. D.

Maj. Henry L. Bowlby, formerly state highway engineer of Oregon, has been appointed senior highway engineer of the office of public roads and rural engineering, Department of Agriculture. His headquarters will be in Denver, Colo. For the past two years he has engaged in private practice as a consulting highway engineer.

C. E. Leonard has been appointed city engineer of Austin, Texas, to succeed M. C. Welborn, who resigned to take a position with the State Highway Commission. Mr. Leonard was bridge engineer of Austin for a year and a half and built about $75,000 worth of reinforced concrete bridges. When this work was completed he was made paving engineer, from which position he was promoted to his present position.

H. Walter Leavitt has been appointed testing engineer of the Maine State Highway Commission and also assistant professor of civil engineering at the University of Maine, Orono, Maine.

J. T. Gear has been appointed city engineer of Puyallup, Wash. He was formerly city engineer of Kelso.

J. W. Greer has been appointed city manager of Bryan, Texas, succeeding W. Pipperman, who resigned to enter the army.

Arthur F. Shuey was recently appointed superintendent of water works at Tampa, Fla.

Miss Esther Jack has been appointed city engineer of Williston, N. D., to succeed E. R. Evans. She is an engineer graduate of the state university.

Bituminous Surfacing for Plank Bridge Floors

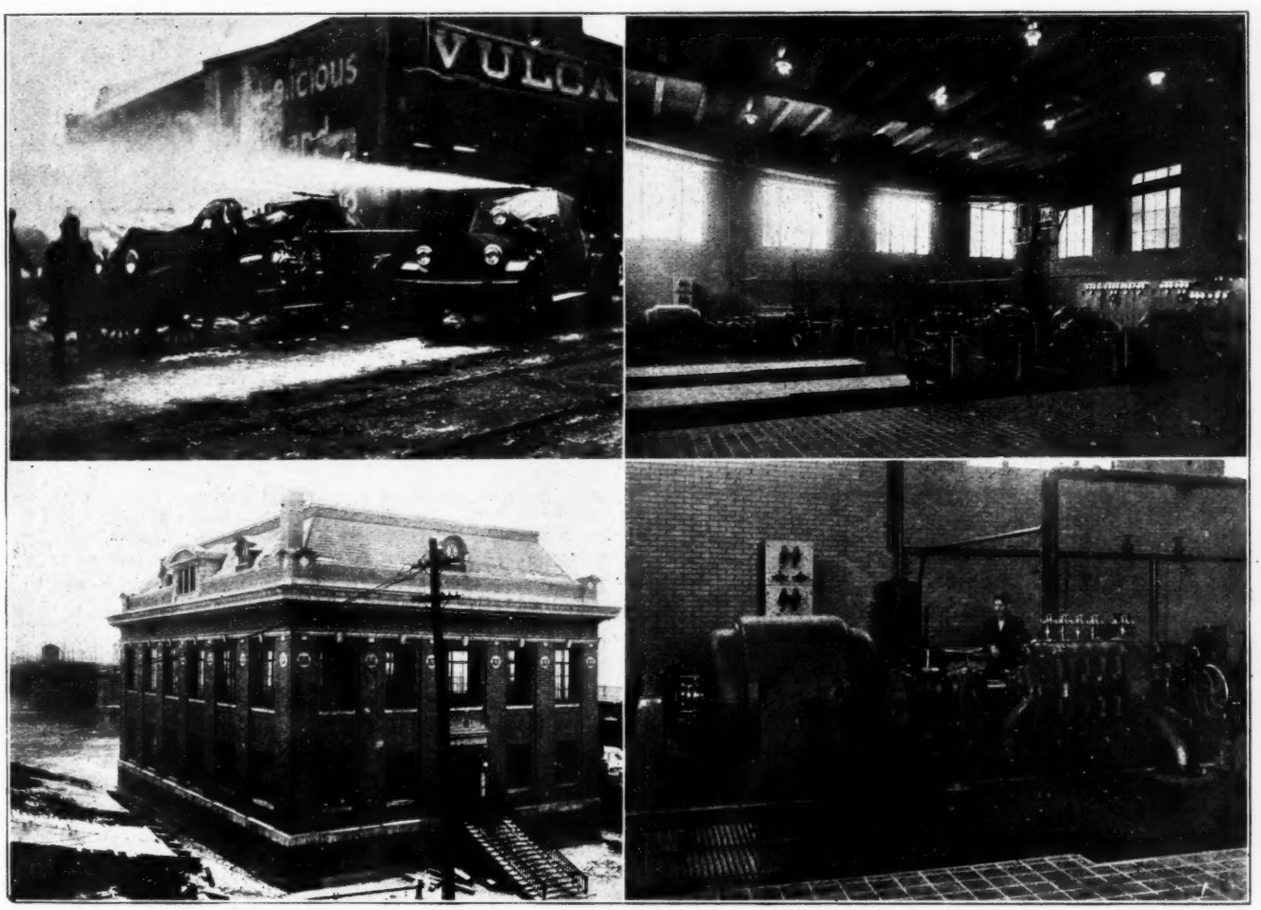
The Minnesota State Highway Commission is advocating the use of a bituminous surfacing for plank bridge flooring. It is claimed for this bituminous surfacing that it may be easily applied, that it lasts as long as the average plank floor and costs only one-third as much. The great objection to the old-time wood bridge floor is the cost of frequent replanking.

FIRE ENGINEERING

The Design, Construction and Operation of Toledo's New High Pressure Fire Protection System

By W. J. Sherman, of the W. J. Sherman Company, Consulting Engineers, Toledo, Ohio

The practically total destruction by fire of the property within the congested value districts of Boston, Chicago, San Francisco and Baltimore because of inadequate fire protection, together with the recognized advantages of lower insurance premiums, has resulted in the establishment of special fire service systems separate and distinct from the domestic service systems for numerous American cities, including New York, Philadelphia, Baltimore, Cleveland, Winnipeg, Toledo and Boston.



VIEWS OF NEW HIGH PRESSURE FIRE PROTECTION SYSTEM, TOLEDO, OHIO.

The High Pressure Mains

An ordinance appropriating $41,570 for the city's portion of the high pressure mains was passed Nov. 21, 1910, and on March 23, 1914, the city council appropriated $20,000 for the purchase of the site for the pumping station, and on May 25, 1914, $180,000 for the station itself.

Under authority from the council there were laid 22,500 ft. of 10-in., 12-in. and 16-in. class "G" extra heavy cast iron pipe in the principal business district bounded on the north by Cherry street from the Maumee river to Superior street, thence south to Jackson avenue, thence west to Michigan street, thence south to Monroe, east to Ontario, south to Washington and east to St. Clair, north to Monroe and east to the Maumee river, embracing an area of 160 acres and protecting approximately 200 acres.

Contracts and Cost

In October, 1914, the writer was engaged by the city to prepare plans and specifications for the pumping station and its equipment, and about May 1, 1915, contracts were awarded as follows, viz:

Substructure—M. F. Conner.

Superstructure—The A. Bentley & Sons Company.

Equipment—The Arrow Engineering Company.

The total cost of the fire service pumping station was well within the appropriation of $180,000, notwithstanding the fact that a third story was provided for the structure since the appropriation was made. This was done for the double purpose of improving the appearance architecturally and also of providing 5,800 sq. ft. of floor space for some one of the city departments. This space has recently been occupied for office purposes by the water works department.

Equipment

The station is intended to be a model one in every respect. It is located on the Maumee river, close to the Maumee bridge.

It is 65 x 90 ft. in plan, with bearing walls of brick and reinforced concrete floors.

The initial installation called for four motor driven, five stage Allis-Chalmers centrifugal pumps, each capable of delivering 2,000 gallons per minute against a pressure of 300 pounds per square inch at a speed of approximately 1,500 r.p.m.

There are blank spaces for two additional pumps. The supply comes direct from the river and the distribution system is entirely separate and distinct from that which carries the filtered water for domestic use.

The motors for driving the pumps are of the alternating current, slip ring induction type; three phase current at 25 cycles and 4,000 volts is supplied for the operation of these motors. The normal rating of each motor is 550 horse power. Current is furnished by the Toledo Railways and Light Company for both A. C. and D. C. circuits, though an emergency direct current motor generator set has been installed.

Meters have been placed in each of the two 16-in. discharge lines, leaving the station with recording rate of flow and total flow gauges.

All important valves are motor operated. A twelve-panel switchboard of Blue Vermont marble has been provided.

The oil switches for the control of the high tension current have been placed in the pipe gallery. Basement drainage is taken care of by means of a vertical sump pump and motor, while for emergency use the larger pumps can take suction direct from the sump.

The high pressure system is kept full of water at all times ready for instant use.

The operator at the fire service pumping station is kept informed of the progress of fires and the requirements of the fire department by telephone and by the fire alarm telegraph system.

Insurance

The Ohio Inspection Bureau classifies municipalities of the state according to their fire fighting facilities. There are ten classes, viz:

Nos. 1, 1½, 2, 2½, 3, 3½, 4, 4½, 5, 6.

Cleveland is the only city in the first class, Cincinnati the only one in class 1½, Columbus the only one in class 2, and Toledo the only one in class 2½, while class 3 comprises Lima, Hamilton, Dayton and Youngstown.

During a general rerating of this city in 1914 the residential districts were transferred from class 2½ to class 1, and within three months after the completion and satisfactory testing of the system it was expected that the property in the congested district would be transferred from class 2½ to class 2.

Tests

The equipment and pipe lines of the high pressure system were subjected to satisfactory tests under operating conditions for several weeks preparatory to transferring the plant from the contractors to the permanent operating force to be maintained there by the city.

The Future

It is proper to call attention to the fact that the pumping capacity of the station, viz., 8,000 gallons per minute from the four pump units already installed with 4,000 gallons per minute additional from the two future pump units, foundations and piping for which are now ready, is sufficient to care for a much larger central territory than the 200 acres protected by the existing system of high pressure mains, and therefore the city should soon undertake the construction of additional mains designed primarily to reinforce the existing system and so located as to provide for territory not now protected by high pressure.

The pumping station is designed for a much larger capacity than the distribution system, and the latter should be enlarged as soon as practicable.

OBITUARIES

William Walter Marr, Chief State Highway Engineer of Illinois, was born in 1876, in Chicago, Ill., of an old American family. He was educated in public and private schools in Chicago and at the University of Notre Dame at South Bend, Ind., graduating from that institution as a Bachelor of Science in 1895, and taking post graduate work in 1896, for which he received the degree of C. E.

In 1897 he entered the employ of the city of Chicago as an assistant engineer, and for several years was employed in various capacities in charge of bridge repairs, water supply, harbor work and tunnel construction, under the general charge of the city engineer.

In 1902 he became Division Engineer for the Board of Local Improvements of the city of Chicago, being in general charge of street paving work for the West Side of Chicago.

In 1908, together with Paul E. Green, he formed the present civil engineering firm of Marr, Green & Company of Chicago.

In 1914 he was appointed by Governor Dunne, a Democrat, as chief state highway engineer, and in 1917 was reappointed to that position by the incoming Republican governor, Lowden. Under his charge the State Department of Highways was practically reorganized and placed on thoroughly efficient basis. Many millions of dollars of work was planned and constructed. At the time of his death he was engaged on far-reaching plans providing for the expenditure of some $60,000,000 for a statewide improvement of roads in Illinois.

He was a member of the American Society of Civil Engineers, of the Illinois Society of Engineers and Surveyors and of the Springfield Engineers' Society.

Mr. Marr had made a special study of municipal paving and country highways. He was widely recognized as an expert of the highest class in these lines, and his advice was in constant demand.

He had made a magnificent record in public office and his reappointment to the position by Governor Lowden was recognition of this fact. He was widely known in Illinois and adjoining states for his splendid technical and executive ability, and was in continuous request as a speaker at good roads conventions and similar movements.

He died October 3, 1917, and is survived by a widow and four children.

Coming Conventions

CITY MANAGERS' ASSOCIATION—Annual meeting at Detroit, Mich., Nov. 19-24. Sec'y, W. L. Miller, City Manager, St. Augustine, Fla.

NATIONAL MUNICIPAL LEAGUE—Annual meeting at Hotel Statler, Detroit, Mich., Nov. 21-24. Sec'y, Clinton Rogers Woodruff, 703 North American Bldg., Philadelphia, Pa.

VIRGINIA GOOD ROADS ASSOCIATION—Annual convention at Richmond, Jan. 15-17, 1918. Sec'y, C. B. Scott, Richmond.

FIRST CHICAGO CEMENT MACHINERY AND BUILDING MATERIAL SHOW—Supersedes annual Chicago Cement Show. To be held under auspices of the National Exhibition Co., 123 West Madison St., at the Coliseum, Feb. 6-13, 1918.